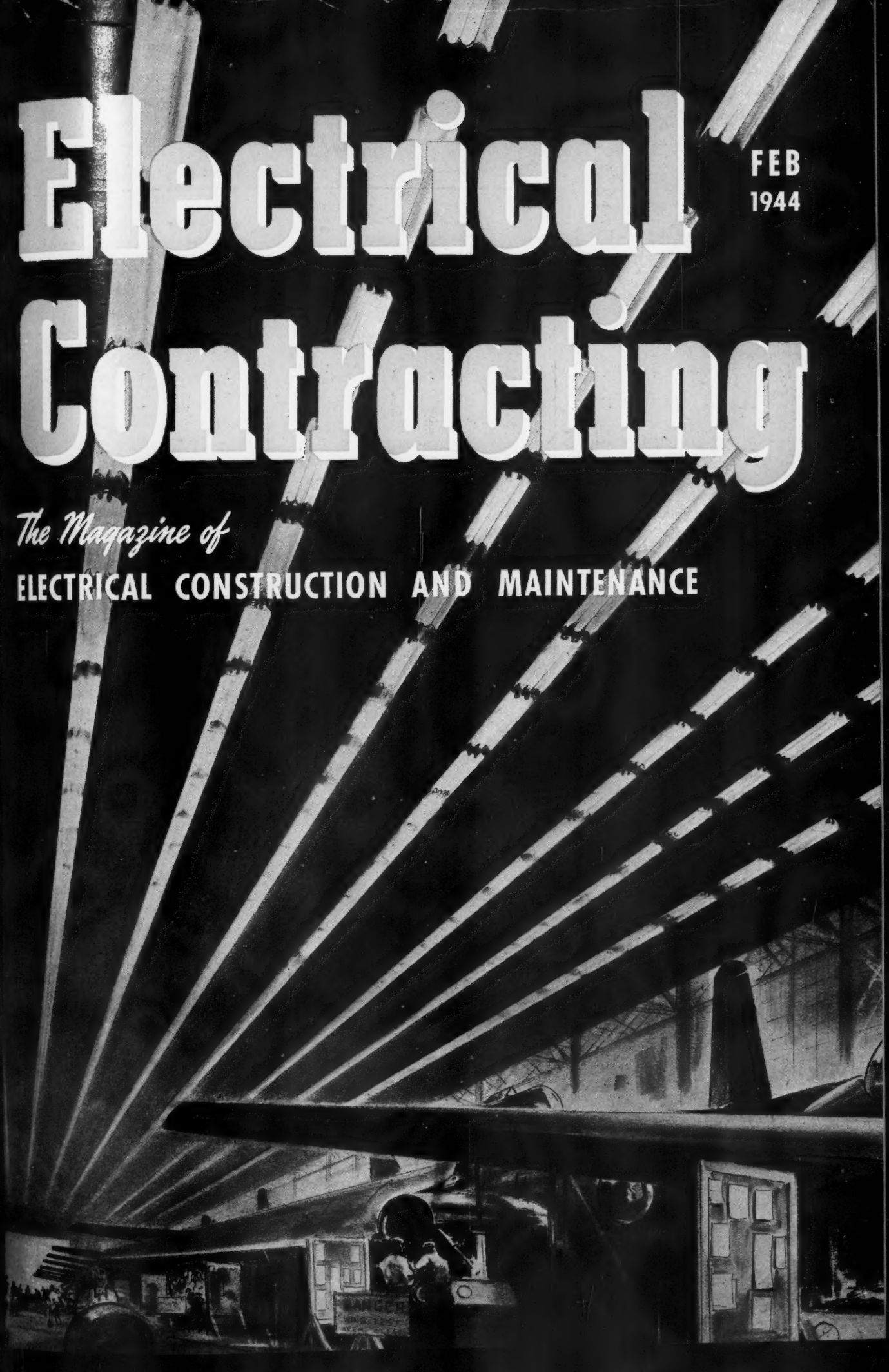
Electrical Contracting

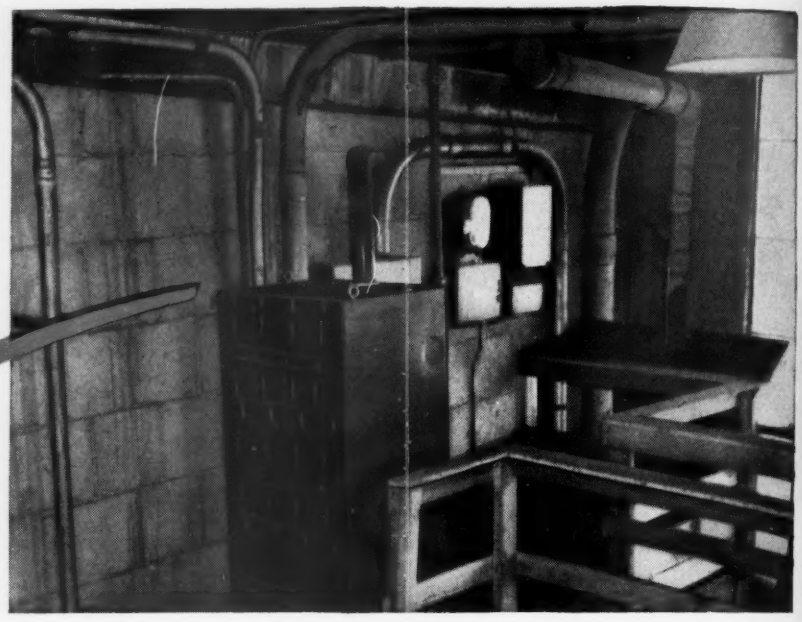
FEB
1944

The Magazine of
ELECTRICAL CONSTRUCTION AND MAINTENANCE



Did You See This News Item?

30% More Capacity — 30% Lower Bill!



Here is a dramatic example of the ability of a bank of capacitors to solve an electrical problem for a busy factory. At the Paxton-Mitchell Co., iron foundry at Omaha, Nebraska, the power demand was 190 kva and the wiring couldn't carry the load properly. Power factor was only 70% but when 90 kva of capacitors were installed the same motors produced a demand of only 145 kva! It has been possible to connect more motors without adding to wire, main switch, fuse or transformer capacity; the cost of the capacitors which cured the low power factor problem will be paid out of savings in about 15 months.

THE CAPACITORS ARE PYRANOL

To this story from *Electrified Industry* we'd like to add only two points. First, because capacitors usually do eliminate the need for extensive rewiring when they are put in to improve power factor (as was the case at this Paxton-Mitchell foundry), they thus save critical material, time, labor, and money. And, second, because Pyranol* capacitors are readily available and are easy to install, they represent today's ***quickest*** method of improving power factor.

If your plant's power system is fully loaded—or overloaded—and is operating at low power factor, ask your G-E representative to estimate how much ***your*** circuit capacity can be increased by Pyranol capacitors. Or write for Bulletin GEA-77. *General Electric Co., Schenectady, N. Y.*

**Reg. U.S. Pat. Off.*

Every week 192,000 G-E employees purchase more than a million dollars' worth of War Bonds.

GENERAL ELECTRIC

407-70-570

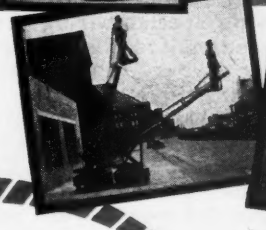
"Murray" – the modern STANDARD in maintenance ladders!

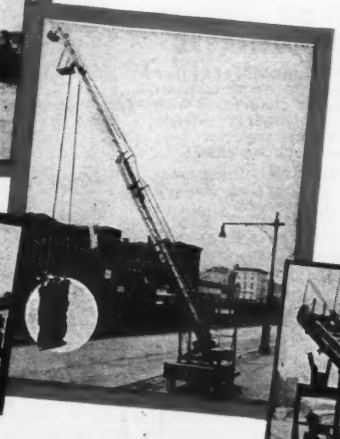
These maintenance units make overhead servicing *so* fast and easy that light output is kept at maximum.

The chief advantage of these Murray Crows'nests is that they make overhead, out-of-the-way lights, unit heaters and sprinkler heads, easily accessible, without disturbing men, machines or production schedules in the slightest.

All the many important plants which have taken on Murray Crows'nests, wonder how any plant ever got along without them. Fill in the coupon and mail—we'll propose a unit suiting your particular needs. Metropolitan Device Corporation, Brooklyn 16, N. Y.

Courtesy "Magazine of Light" General Electric Co.





Courtesy "Magazine of Light" General Electric Co.

Metropolitan Device Corp.
Brooklyn 16, N. Y.

Send data (without obligation) on Murray Crows'nest suitable for our requirements.
Ladder must reach _____ feet high, and extend _____ feet side-ways. Aisle width is _____ feet.

Name and Title _____

Company _____

Address _____

Murray crows'nest

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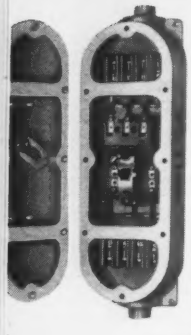
On Guard!

Type "FSQX", Appleton Explosion-Proof, Dust-Tight Receptacle with Safety Switch and Plug.

APPLETON DEAD-END RECEPTACLE AND PLUG

No hot terminals when in use! Plugs must be inserted and fully seated before contact is made—typical practical, skillful Appleton engineering. No exposed live parts. Plug cannot be pulled until *after* circuit is broken. Wide variety of types and sizes.

SAFE POWER and LIGHT
For Busy Hazardous Locations



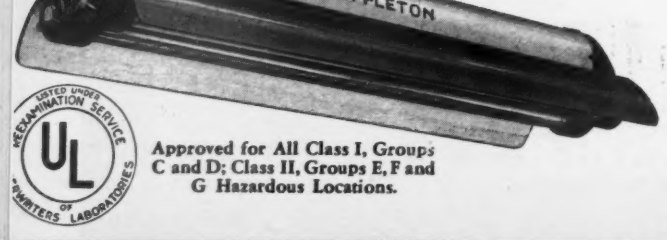
"SEAL-LINE" EXPLOSION-PROOF SWITCH UNILETS

Completely eliminate need for sealing fittings. Each unit consists of three distinct chambers—with middle switch chamber completely isolated. Line wires are drawn into upper and lower splicing chambers.

LEFT—"SEAL-LINE" Explosion-Proof Motor Starting Switch Unilet; Cover Removed.
RIGHT—"SEAL-LINE" Explosion-Proof Circuit Breaking Switch Unilet; Closed.

First EXPLOSION-PROOF FLUORESCENT LIGHTING FIXTURE

Complete Appleton line also includes types for incandescent lamps in any combination of guards, reflectors and suspension.



Approved for All Class I, Groups C and D; Class II, Groups E, F and G Hazardous Locations.

● APPLETON EXPLOSION-PROOF FITTINGS LIGHTING FIXTURES Give a Wide Margin of Safety

SAFEGUARD personnel and equipment against disastrous explosion—in chemical plants, powder mills, oil refineries, rubber plants, lacquer departments!

Appleton Explosion-Proof Electrical Equipment makes circuits safe in hazardous locations, increases their efficiency. Appleton Explosion-Proof Dead-End Receptacles, "Seal-Line" Switch Unilets, and hundreds of explosion-proof conduit fittings serving special wiring requirements—all are expertly designed and built to give a wide margin of protection. They are Appleton types—approved by Underwriters' Laboratories—for every installation.

Rugged, MALLEABLE IRON bodies and covers are cast in Appleton foundries; the entire manufacturing operation is under one unified responsibility and control. Completeness of the Appleton line simplifies selection of proper equipment for every use.

Save time and worry—with safety—by specifying Appleton Conduit Fittings, Lighting Fixtures. They're "STANDARD FOR BETTER WIRING!"

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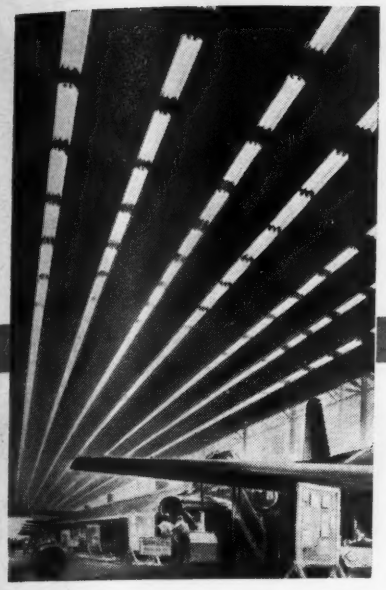

OUR COVER this month is "Aircraft Production Lighting," the sixth in a series of original sketches of electrical equipment in wartime by Artist Stephen Grout.

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A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering, installation, repairing, maintenance and management, in the field of electrical construction and maintenance.

Electrical Contracting

With which is consolidated The Electrogist and Electrical Record ... Established 1901

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Yes, you Can combine
GOOD LIGHTING *with* GOOD LOOKS!

Guth FLUORESCENT

for Dependable Illumination in Attractive Fixtures

HERE are four of the new Fixtures from the **complete** line of GUTH Commercial Fluorescent. A glance tells you they're smartly styled—modern as tomorrow!

Besides these new Commercial types, there are new Industrial units to increase your 1944 lighting sales. And they're all efficient! With more than 40 years of lighting leadership, GUTH has engineering experience to build quality into GUTH Lighting.

Write today for new GUTH Catalog No. 42.

★ ★ ★ ★ ★ ★ ★ ★

Leaders in Lighting Since 1902 **Guth**

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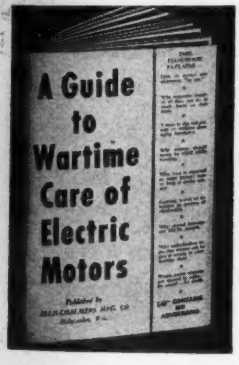
THE EDWIN F. GUTH CO. • 2615 Washington Ave. • St. Louis, Mo.

FIRST AID FOR MOTORS

MOTORS RUN A FEVER? No wonder if they do more often today. They're working *3 and 4 times* as many hours as in peace!

Wartime conditions demand you diagnose motor ailments *quickly* ... remedy the trouble at once. At right are but few of the many diagnoses found in Allis-Chalmers' new "Guide to Wartime Care of Electric Motors". In maintenance as in war, *attack is the best defense.* This book singles out the 9 main enemies of electric motors . . . tells you how to get them *before* they get your motors!



Over 100,000 copies already in use.

Write today for your *free* copy. ALLIS-CHALMERS MFG. CO., MILWAUKEE 1, WIS.

SYMPTOMS YOU CAN *SEE*

Symptom	Possible Causes	Cure
1. Excessive sparking or flashing at brushes. Blackened commutator.	Rough commutator.	Sand or turn down, depending upon depth of surface roughness.
	Low bar on commutator.	Grind or turn down balance of commutator.
	High bar on commutator.	If extreme, lower with mallet, tightening clamping ring. Grind true.
	Brushes too short.	Replace with harder grade—if worn too soon . . . and not by rough commutator.
	Shorted armature winding.	Test for short—after removing metallic contact between commutator bars. Repair.
2. Intermittent sparking at brushes.	Open armature winding.	Locate and replace bad coil—or repair defective joint.
3. Motor won't start.	Usually line trouble.	Correct. Check source of power supply.
	Load too heavy. See if motor runs without load.	Reduce load—or replace motor with unit of greater capacity.

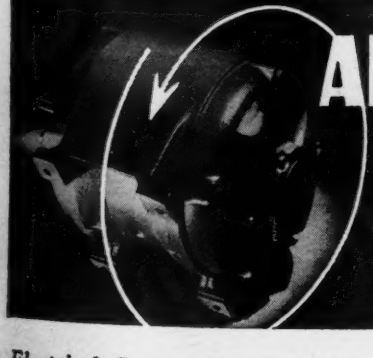
SYMPTOMS YOU CAN *HEAR*

4. Excessive hum.	Uneven air gap. Measure with feelers.	Replace bearings—before introduction of scraping noise indicates rotor is rubbing.
	Unbalanced rotor. Check on parallel bars.	Balance with solder on band—or weight attached by cap screw and lock washer.
5. Regular clicking.	Matter in air gap.	Take out rotor; remove matter.
6. Rapid knocking	Misalignment.	Realign set until knocking disappears.
7. Brush "chatter."	Extreme vibration.	See item 10, below.

SYMPTOMS YOU CAN *FEEL*

8. Vibration.	Misalignment.	Realign set.
	Vibration in driven machine.	Eliminate source in machine, if possible. Or a flexible belt drive may be in order.
9. Motor overheating. (Check with thermometer—don't depend on hand).	Overload. Measure load; compare with nameplate rating.	Check for excessive friction in motor, drive or machine. Reduce load, or replace motor with greater capacity unit.
	Dirt in motor. Check flow of air.	Blow out motor. Use solvent on wound section if necessary.
	Rotor rubs stator.	Replace bearings.

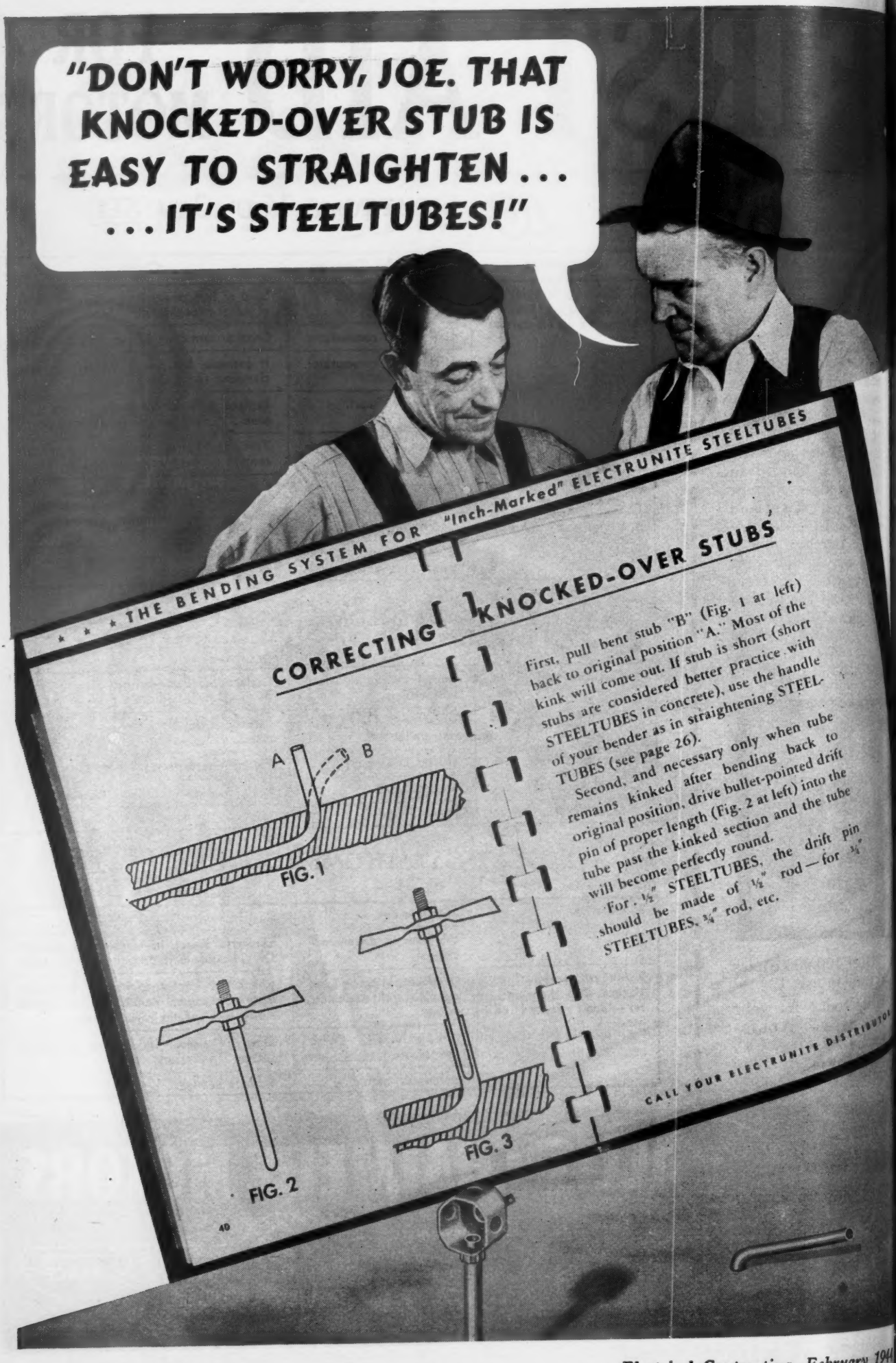
A 1638



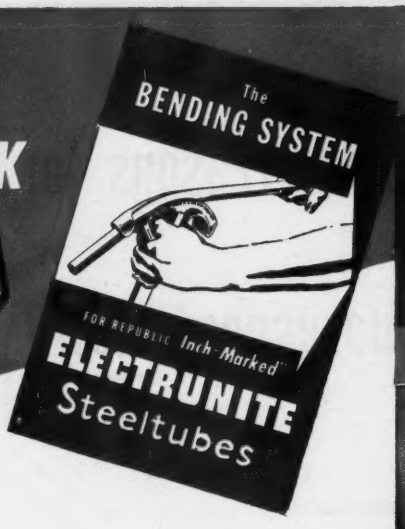
ALLIS-CHALMERS MOTORS

When you do need new motors, look into the strength, solidity and all-around protection of the new "Safety Circle"—protected top, sides, ends and bottom.

AC WE WORK FOR VICTORY WE PLAN FOR PEACE


"DON'T WORRY, JOE. THAT KNOCKED-OVER STUB IS EASY TO STRAIGHTEN . . . . . IT'S STEELTUBES!"
★ ★ ★ THE BENDING SYSTEM FOR "Inch-Marked" ELECTRUNITE STEELTUBES
CORRECTING KNOCKED-OVER STUBS
First, pull bent stub "B" (Fig. 1 at left) back to original position "A." Most of the kink will come out. If stub is short (short stubs are considered better practice with STEELTUBES in concrete), use the handle of your bender as in straightening STEEL-TUBES (see page 26).
Second, and necessary only when tube remains kinked after bending back to original position, drive bullet-pointed drift pin of proper length (Fig. 2 at left) into the tube past the kinked section and the tube will become perfectly round.
For ½" STEELTUBES, the drift pin should be made of ½" rod—for ¾" STEELTUBES, ¾" rod, etc.
A
B
FIG. 1
FIG. 2
FIG. 3
CALL YOUR ELECTRUNITE DISTRIBUTOR
40

AND THIS BOOK shows how to do it



Because of its uniform ductility—resulting from close control throughout every step of manufacture—ELECTRUNITE STEELTUBES bends and rebends with remarkable ease. And this 68-page book will enable you to take full advantage of this quality.

It shows and tells how to correct knocked-over stubs, how to shift stubs and how to make basic bends to measurement without backtracking.

It gives detailed instructions for using the ELECTRUNITE and Hickey Benders to obtain best results.

It also contains useful tables on allowable current-carrying capacities of conductors, number of conductors in conduit or tubing and minimum foot-candles for efficient lighting. In it you will find tips on the care and maintenance of electrical equipment.

Republic "Inch-Marked" ELECTRUNITE STEELTUBES E.M.T. is remarkably easy to use—when you take advantage of all its work-simplifying features. This book will show you how to obtain best results.

If you have anything to do with the installation of electrical raceways, you should have a copy. Write for it—it's FREE.

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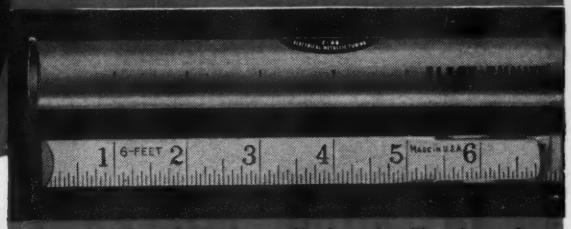
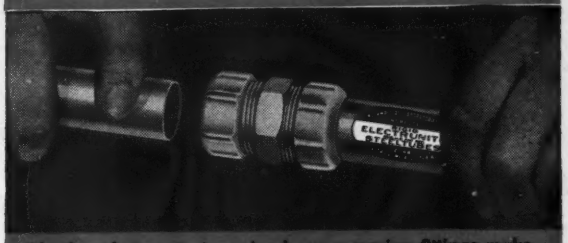
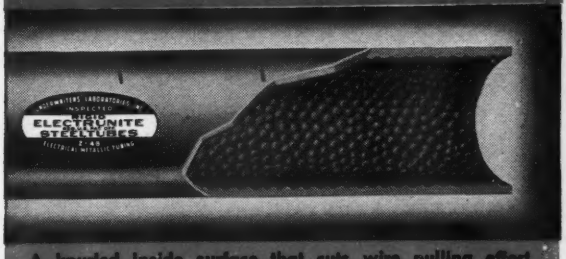
NOTE THESE FEATURES OF ELECTRUNITE STEELTUBES



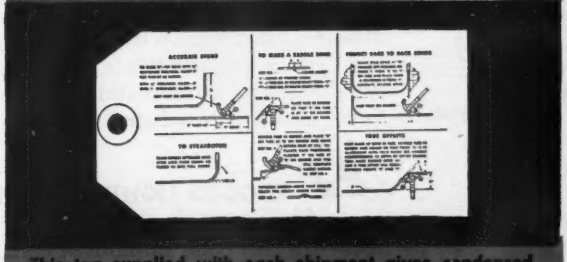
Every length marked in foot and inches—just like a foot-rule.


No threads to cut—two simple compression fittings make watertight joints.



A knurled inside surface that cuts wire pulling effort up to 30%.

The ELECTRUNITE Bender predetermines bends—makes them easily and accurately.


This tag supplied with each shipment gives condensed bending instructions.

REPUBLIC STEEL
PRODUCTION FOR VICTORY

Republic "INCH-MARKED" ELECTRUNITE Steeltubes
Reg. U. S. Pat. Off.
ELECTRICAL METALLIC TUBING MARKED WITH A CONTINUOUS FOOT-RULE

Can you think of 7 better reasons for installing MILLER Fluorescent now?

Here are provable facts—facts that have caused war industry to insist upon MILLER 50 & 100 FOOT CANDLER Continuous Fluorescent Lighting Systems . . .

1 **NEW, IMPROVED DESIGN** of the Miller Continuous Wireway Flourescent Lighting System, constructed to comply with wartime regulations for conservation of critical materials —the same as introduced in 1939.

2 **RUGGED LIGHTWEIGHT EQUIPMENT** —rigid compact channels and Masonite reflectors—no reduction in lighting efficiency.

3 **EXPOSED BALLAST** for coolest possible operation—all wiring concealed but accessible upon removal of lightweight reflector.

4 **LAMPHOLDERS** rigidly mounted back-to-back for mutual stiffening and maintenance of spacing. Miller patented lamp lock also available, minimizing danger of falling lamps.

5 **LOW INSTALLATION COST** — savings of 30-50% again possible by use of 8 foot and 10 foot rugged double length channels—one suspension per channel section—simplified wiring in continuous rows.

6 **SIMPLIFIED MAINTENANCE**—ballasts, lampholders and starters readily accessible—starters located between lamps.

7 **UNIFORM ILLUMINATION**—the 30 to 50 or more footcandles required for war production easily obtainable from practical row spacings.

We suggest you write or wire today for complete information.

THE MILLER COMPANY • MERIDEN, CONNECTICUT

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Fluorescent, Incandescent
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Domestic Oil Burners
and Liquid Fuel Devices

ROLLING MILL DIVISION
Phosphor Bronze and Brass
in Sheets, Strips and Rolls

WAR CONTRACTS DIVISION
War Materiel

MILLER
SINCE 1844

TALKING DISTANCE...OVER 5 MILES...
Laytex Assault Wire assures clear, sure transmission of messages—a prime military requirement for battlefront communications. An invaluable property when advance scouts have been cut off from their company and virtually surrounded in enemy territory.

LAYTEX ASSAULT WIRE IS LIGHTWEIGHT
...and fully dependable. One man carries enough wire to keep communications open—travels fast and far without being hampered by excess, needless weight.

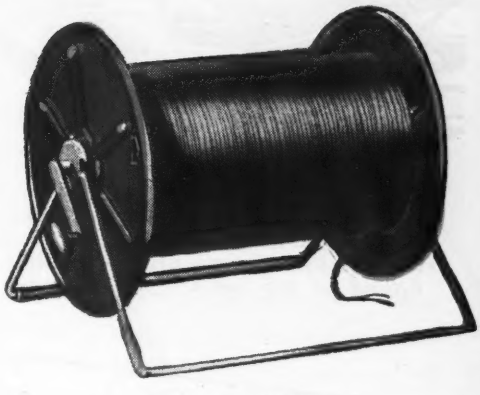
JUNGLE DAMP'S A KILLER

The jungle's a dirty fighter. Vines and underbrush seem to grow across your way while you watch them. The sun doesn't get through...and it's damp. The heavy, hot kind of damp that means mildew and decay to every piece of equipment not specially made or treated to resist them.

Laytex Assault Wire is specially made to resist damp. The high quality, uniform insulation is entirely free from water-soluble elements. It is unaffected by prolonged exposure to moisture, provides maximum protection to the accurately centered conductors.

Not only that...the special Laytex Insulation has high resistance to concussion and does not become embrittled when wire is subjected to repeated vibration and shock. It readily withstands temperature changes. Its uniformly high quality permits the thickness of the insulation to be kept at the minimum. As a result, Laytex Assault Wire is extremely lightweight. A mile weighs less than 30 pounds. Laytex Assault Wire has a talking distance of better than 5 miles, and was developed for front line service by United States Rubber Company scientists working in close cooperation with engineers of the Army Signal Corps.

These same properties—light weight, small diameter, ability to withstand temperature changes, flexibility and toughness make other types of Laytex Wires and Cables as important in peacetime industry and building as they are to the Armed Forces.



Laytex
ASSAULT WIRE

SERVING THROUGH SCIENCE

UNITED STATES RUBBER COMPANY

1230 Sixth Avenue, Rockefeller Center, New York 20, New York

This BullDog Vacu-Break Switchboard controls blower operation. Note space for additional circuits.
Three BullDog Vacu-Break Switches are used in connection with the heat treatment of aircraft rivets.

PAN AMERICAN CHOSE *Vacu-Break*

BullDog Switches and Switchboards Control Light and Power Throughout New Million-Dollar Miami Hangar

Constructed as a unit, the new Miami building illustrated above, includes three four-story shop and office buildings divided by two hangars.

Largest and costliest of all structures in the far-flung Pan American World Airways System is this giant maintenance and office building — a monument to U. S. leadership in the skies.

That BullDog electrical equipment is used to control light and power throughout this giant aircraft center is a tribute of which we are proud.

Choice of switches, switchboards, panelboards for such great installations is not lightly made. Decisions are based on superior design, greater safety and dependability, longer life and lower upkeep cost.

BullDog meets these requirements squarely and completely — with the famous Vacu-Break principle which assures the most positive action, maximum safety and minimum wear.

Whatever the electrical problems of your plant or offices, BullDog engineers can contribute to the results you want. Write today for a descriptive booklet giving full information.

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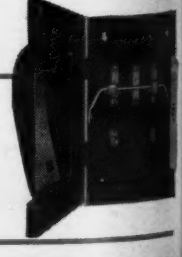
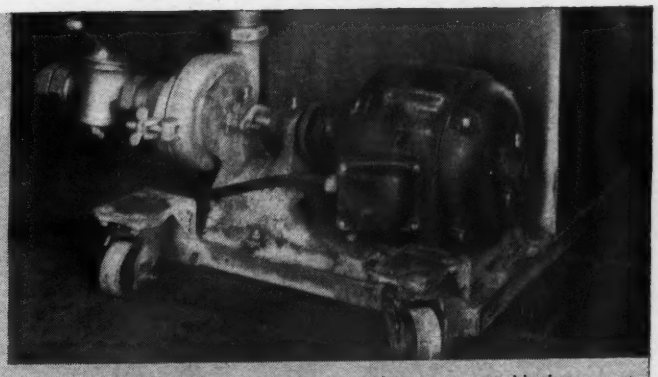
Field Engineering Offices in All Principal Cities



In addition to Vacu-Break Safety Switches, BullDog Electric Products Company manufactures a wide variety of products for power distribution and control, including SafToFuse Panelboards, Circuit Master Breakers, Switchboards and the three famous Bus Duct Systems — BUStribution DUCT, *for "plug-in" power*, Universal Trol-E-Duct, *for flexible lighting*, and Industrial Trol-E-Duct, *for movable "loads."*

DOUSED DAILY!

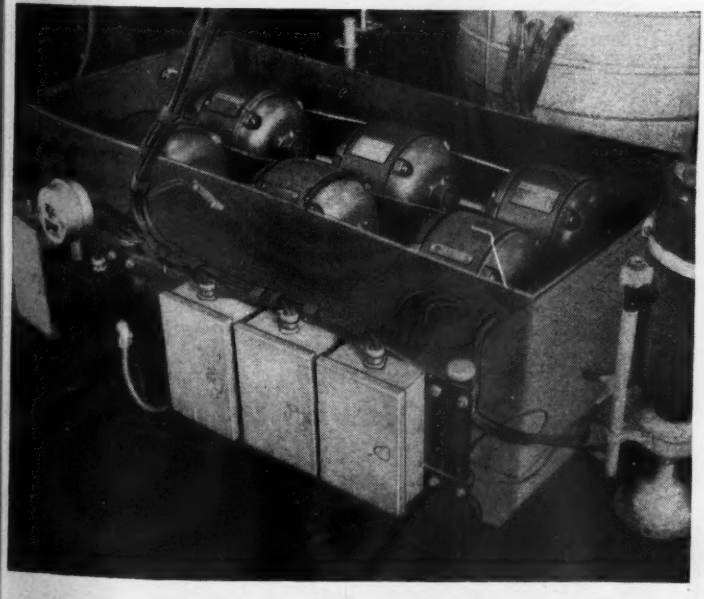


G-E Tri-Clad motor coupled to a centrifugal pump on a portable cleaner in the milk plant of H. P. Hood & Sons, Inc., Charlestown, Mass.

POWERING A DAIRY PUMP, this Tri-Clad splashproof motor gets a dousing every day as the plant is hosed down. After years of service, frame and end shields are virtually uncorroded, insulation is going strong. G-E "protection tests", both in the development of the Tri-Clad design and in our daily production, help us assure you of long-lasting service from Tri-Clads on motor-wracking jobs like this.

"Hot Box" at 100% humidity tests TRI/CLAD motor protection

REG. U.S. PAT. OFF.



Here is one of the many development tests which helped to prove the *extra* stamina engineered into the Tri-Clad design. In the bottom of this moisture box, just below the motor base, two inches of water was maintained at 212 F. The cover kept the humidity within the box at 100 per cent. By operating motors in this atmosphere to the breakdown point, G. E. got the low-down on the coil insulation's moisture resistance. Tri-Clad motors, in both open and splashproof construction, showed up unusually well in this extra-severe test. *General Electric Company, Schenectady, N. Y.*

GENERAL ELECTRIC

Every week more than 192,000 G-E employees purchase more than a million dollars' worth of War Bonds.

For SAFETY'S sake . . . use CONDUIT

(Full Weight Rigid Steel)

WHEN steel conduit is available for general use again, you will want to rewire many of your wartime systems -- especially to replace substitute material in such critical places as these:

1. Where there is excessive vibration.
2. Where corrosion is a possibility.
3. Where there is moisture or vapor.
4. Where accumulating dust and dirt form a hazard.
5. Where there is danger of crushing or mechanical injury.

Standard-threaded full-weight rigid steel conduit affords the only sure protection against such hazards, because it has strength that endures. The most widely used rigid steel conduit, preferred by electrical contractors for its unvarying strength and durability, is YOUNGSTOWN BUCKEYE CONDUIT.

Above - This installation will last as long as the building itself stands, complete protection for complex wiring systems.

THE YOUNGSTOWN SHEET AND TUBE COMPANY
YOUNGSTOWN 1, OHIO
Manufacturers of
CARBON, ALLOY AND YOLOY STEELS

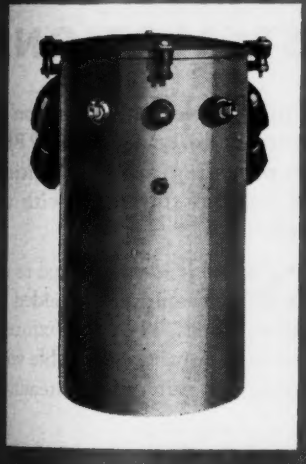
Ask your distributor for:
Youngstown Buckeye Conduit . . . Pipe and Tubular Products . . . Sheets . . . Plates . . . Tin Plate . . . Bars . . . Rods . . . Wire . . . Nails . . . Tie Plates and Spikes

Standard
TRADE MARK

DISTRIBUTION TRANSFORMERS

Engineered and Built to your Requirements

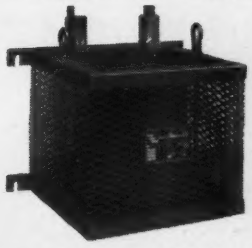
Illustrating two popular types of STANDARD Distribution Transformers: (*right*) 250 KVA Liquid Cooled, 2400 volt unit; (*below*) type A, 15 KVA, 2400—120/240 volt transformer. Standard Distribution Transformers are built in capacities from 1.5 to 500 KVA, all commercial voltages, frequencies, etc.



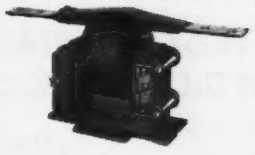
Serving industrial plants, municipalities, mines and utilities everywhere, Standard Transformers are engineered and built to fulfill the special requirements of each particular job. Shown above are two types of Distribution transformers—and at the right are representative units from several other classifications of our complete line. Standard Transformers are made in capacities up to 10,000 KVA self-cooled and voltages up to 69,000 inclusive.

Write for complete information on the many advanced engineering and construction features that make STANDARD Transformers economical and dependable in service.

Other STANDARD TRANSFORMERS

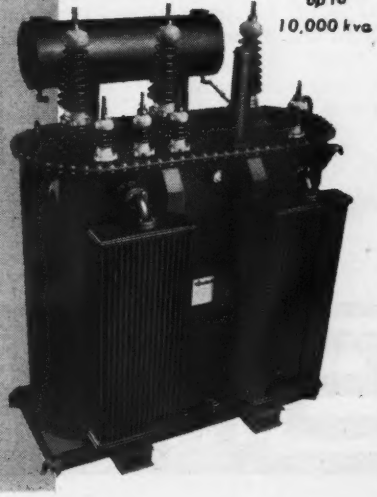


Dry Type . . . Indoor



Instrument Transformers of All Types

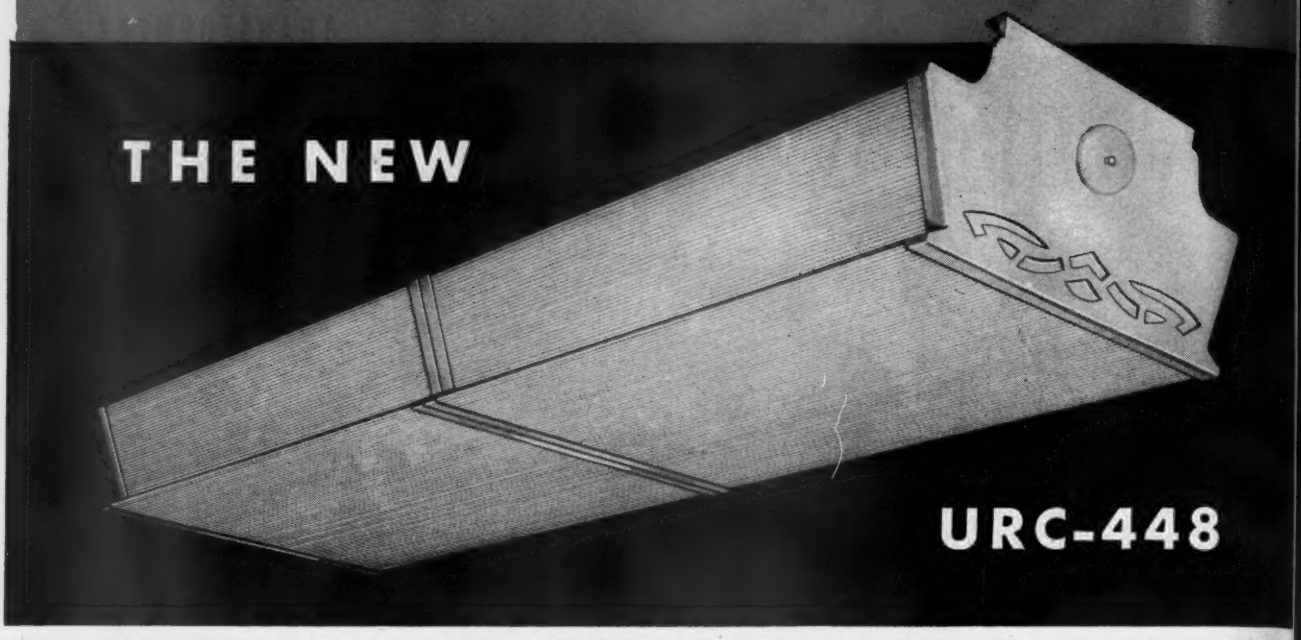
Power Transformers up to 10,000 kva



STANDARD
TRANSFORMER COMPANY WARREN, OHIO

Representatives in Principal Cities

An Engineering Achievement



SPERO U. R. C. FLUORESCENT FIXTURE

GET THESE ADVANTAGES OFFERED IN THE NEW U. R. C. DESIGN

HIGH LIGHT INTENSITY—Tests show 16 foot candles per watt per square foot—evenly distributed.

LOW SURFACE BRIGHTNESS—Resulting from specially developed prismatic, diffusing glass panels.

SPERO "INSTA-LITE"—Providing instant lighting without starter. At slight extra cost.

ATTRACTIVE MODERN DESIGN—Engineered for most efficient light distribution.

INSTALLATION SIMPLE AND QUICK—For pendant type, flush or continuous row mounting.

EASY MAINTENANCE—Glass panels readily removed for cleaning and servicing lamps. Wiring channel easily accessible from below.

SPERO U. R. C. DESIGN—Meeting "Better Light—Better Sight" requirements, and conforming to the latest W.P.B. limitation order on use of metal.

IDEAL FOR ALL TYPES OF COMMERCIAL INSTALLATIONS

This new unit was developed by the Utilities Research Commission to meet the demands for a fluorescent fixture complying with WPB Limitation Order L-78, at the same time providing a highly efficient shielded light source and approaching natural daylight, with all objectionable glare and shadow eliminated.

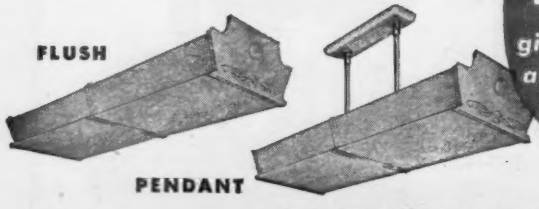
Its attractive lines and scientific engineering make it ideally suited to all types of commercial installations. The four 40 watt lamps are shielded by translucent diffusing glass panels on bottom and sides. The same fixture is adaptable to pendant, flush and continuous-row mounting. Available with Spero "Insta-Lite"—for instantaneous starting and reduced maintenance.

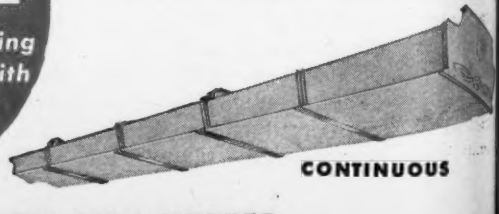
LIST PRICE Less Tubes **$39.95** West and South $43.95

With SPERO INSTA-LITE $51.95
West and South $55.95
For Pendant Type Mounting, add $1.75

Write today for descriptive literature

Also available with
INSTA-LITE
gives you Instant Starting and Instant Lighting with NO starting switch





THREE TYPES OF MOUNTING WITH THE SAME FIXTURE

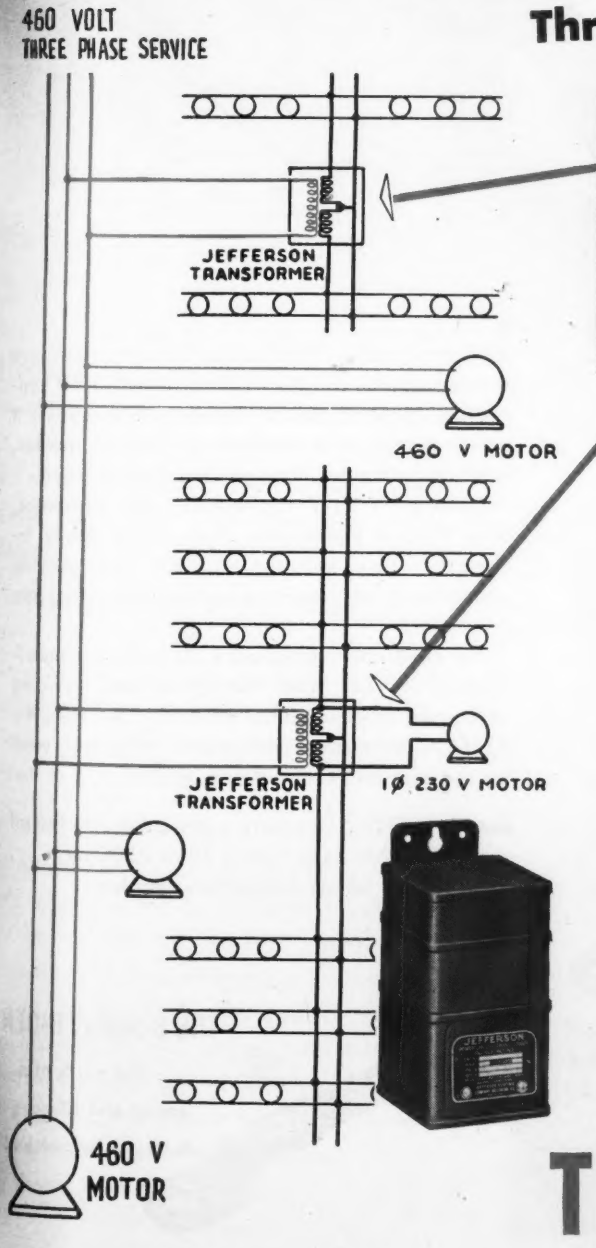
THE SPERO ELECTRIC CORPORATION
18222 LANKEN AVE. ★ CLEVELAND, OHIO

SAVE COPPER · ·

SAVE MANPOWER · ·

SAVE CONDUIT · ·

RUN ONLY HIGH VOLTAGE CIRCUITS Throughout Plant or Building



Install Dry-Type Jefferson Electric Power Circuit Transformers for the Lower Voltage Circuits ▪ ▪ ▪

■ Operate lighting load, fractional H. P. motor and appliance from 3-Phase 460-Volt Power lines by use of Jefferson Power Circuit Transformers for reducing voltage to conventional 115/230 Volts single phase at usage points. This system may be employed in new buildings, saving conduit, copper and manpower, or in old plants where power increases require larger lines to carry the load. In the latter case the 230/115V system can be changed to 3-Phase 460-Volt and carry twice the load previously carried while using the same wires and the same conduit already installed.

Ideal for tall buildings, plants, mines, warehouses, depots, campsites, shipyards and the like. For complete data refer to Bulletin 421-PCT. JEFFERSON ELECTRIC COMPANY, Bellwood (Suburb of Chicago), Illinois. Canadian Factory: 60-64 Osler Avenue, W. Toronto, Ontario.

JEFFERSON ELECTRIC

TRANSFORMERS

The tool that replaces the torch...

IT'S the Burndy HYTOOL . . . the easy-to-use indenting pliers which *indent* Burndy HYDENT connectors to wires merely by closing the jaws. It makes a small wire electrical connection quicker, *surer and stronger*, than by any other method.

Burndy HYDENT connectors, are one-piece, *pure copper* connectors. Thus, when firmly indented to wires with the HYTOOL, they provide connections of *maximum conductivity*, that are *on to stay!*

For electrical maintenance, as well as in manufacture, you can *lower installation and servicing costs*, and *improve circuit efficiency*, by using the HYTOOL instead of the torch. Why not send for the new HYDENT catalog, today?

Burndy HYDENT Connectors are available for all wire and cable sizes from #30 to 2500 mcm . . . and in types for all connection problems.

Burndy Headquarters for CONNECTORS

BURNDY ENGINEERING CO., INC.
107 EASTERN BOULEVARD, NEW YORK 54, N. Y.

THE BURNDY INDENT

. . . the mark of a sound and efficient electrical connection!

DON'T HANG YOUR PRODUCTION ON A *Shoestring* PLANT POWER SYSTEM

● **POWER DISTRIBUTION SYSTEMS,** like shoestrings, are generally kept in service till something ***snaps.*** Minor troubles are laid to other causes, and major breakdowns come too late for preventive remedy.

Today, many otherwise well-equipped plants are "just getting by on a shoestring" when it comes to electric power supply, with make-shift circuits, hand-me-down equipment, and long, overloaded feeders.

If your power system was adapted and extended under pressure to carry loads it was never designed to meet, the chances are that it's partly or wholly inadequate—it's the overlooked cause of outages, poor lighting, sluggish drives, high power losses, extra maintenance expense, and danger to personnel. Nurse it through for the time being if you must, but plan your next move to get away from these risks and losses.

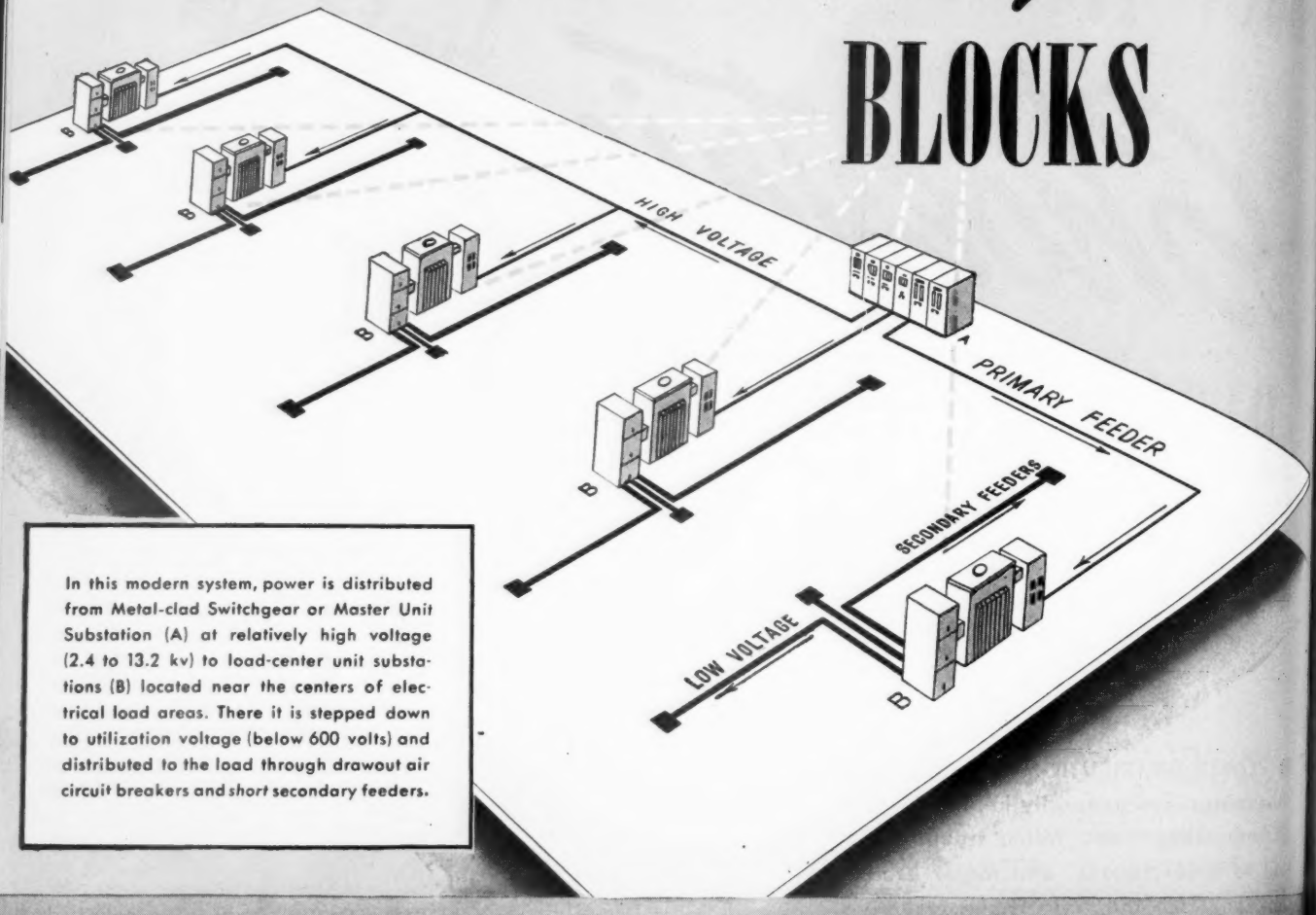
HERE'S *News* . . .

of modern power distribution—G.E.'s load-center system, which you can install as a complete system, or block by block until the complete system is assured.

GENERAL ELECTRIC

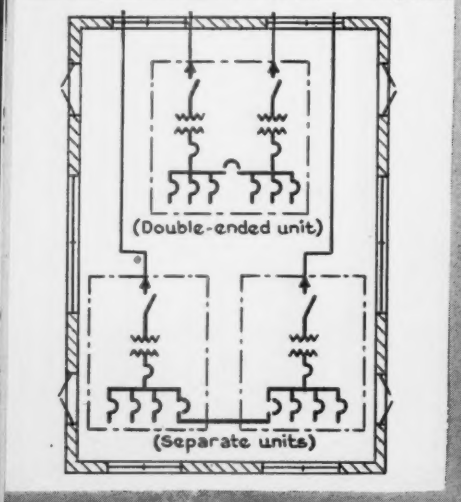
302-27-5900

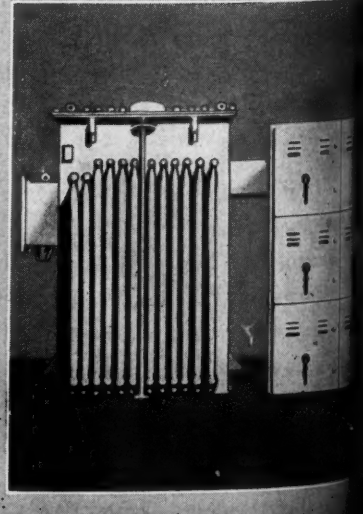
Electric POWER-SUPPLY SYSTEM *based on ready-built* BLOCKS



In this modern system, power is distributed from Metal-clad Switchgear or Master Unit Substation (A) at relatively high voltage (2.4 to 13.2 kv) to load-center unit substations (B) located near the centers of electrical load areas. There it is stepped down to utilization voltage (below 600 volts) and distributed to the load through drawout air circuit breakers and *short* secondary feeders.

THE CIRCUIT ARRANGEMENT YOU NEED — BUILT UP FROM CO-ORDINATED UNITS — OF STANDARD DESIGNS





No system is more *flexible* than load-center distribution. Units can be combined in any one of a number of basic circuit arrangements. (Diagram shows secondary-selective hook-up.)

Like a set of blocks, the elements that go to make up a complete electric power system can be combined in many ways, without engineering or construction delays. All parts are designed to work together.

The components of a G-E unit subst are of standard design. Installation maintenance are simplified; no w about oddities or misfits. You get ex the right assembly for the load condi

SAFEGUARDS

Your Plant from Crippling Outages

THIS MODERN SYSTEM FOR DISTRIBUTING ELECTRIC POWER protects your plant from power shutdowns in two ways: Low-voltage power is distributed from unit substations within definite load areas. Circuit protection here ISOLATES trouble, leaving all other areas unaffected.

In addition, each individual substation is unusually strong in SELF-PROTECTION features. By co-ordinated "system" arrangements, two or more sources of supply to any local circuit can easily be provided.

DELIVERS

Full Voltage to Every Lamp and Machine

LONG, CIRCUITOUS LOW-VOLTAGE FEEDERS are eliminated by the load-center system. This ends the basic cause of most low-voltage troubles, and limits costly IR-drop losses. Dim lighting and sluggish power are avoided. Each substation is matched to local load conditions within your plant, and delivers full-voltage power over short, direct feeders to motor controls, lighting panels, and the like. Wiring problems are simplified. Naturally, this method also means great savings in cable copper.

Ask for Bulletin GEA-3758A

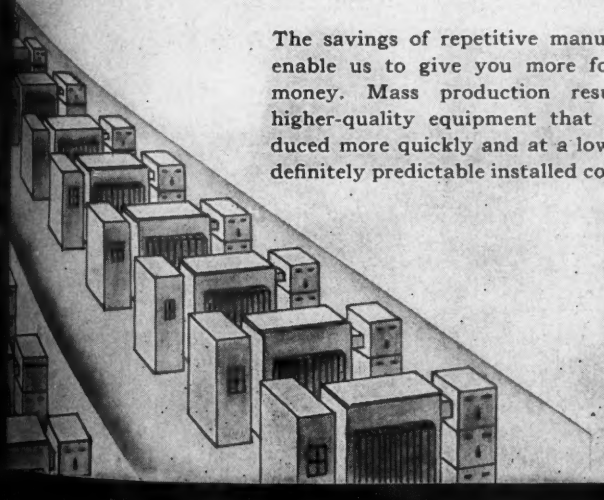
SAVES TIME

In Plant Planning and Conversion

LOAD-CENTER POWER DISTRIBUTION SYSTEMS enable your engineers to make maximum use of available standard apparatus such as unit substations and metal-clad switchgear. They can be laid out by means of a simple "one-line" diagram, fitting ready-built equipment combinations to your specific needs. This method permits placing orders months earlier, and thereby gets plants into production sooner.

If plant conversion alters power loads, substations can be quickly relocated.

REPETITIVELY MANUFACTURED

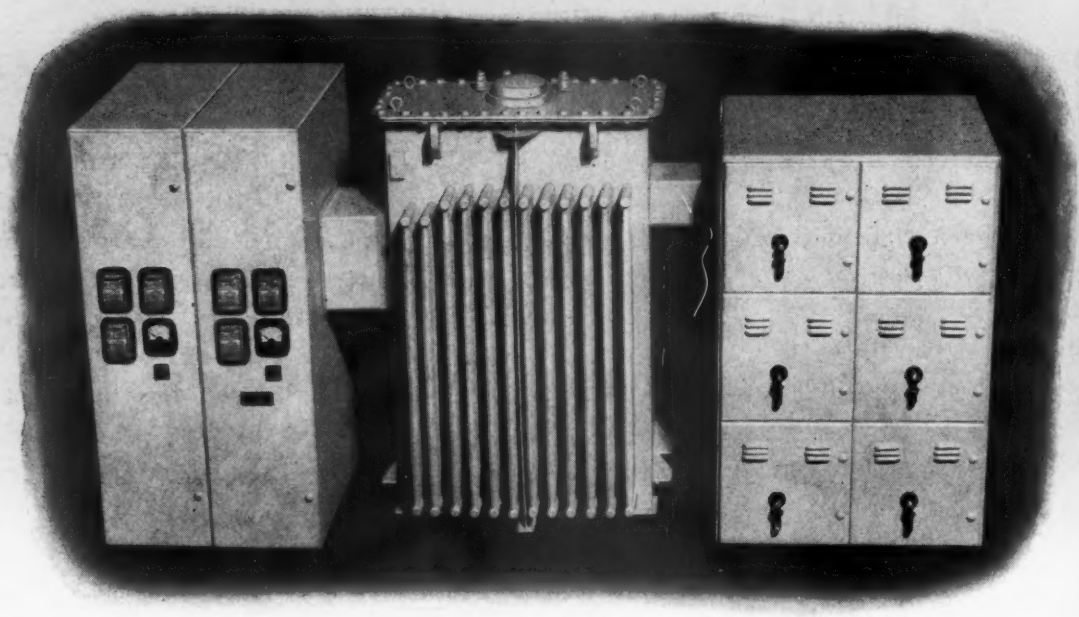


The savings of repetitive manufacture enable us to give you more for your money. Mass production results in higher-quality equipment that is produced more quickly and at a lower and definitely predictable installed cost.

LOAD-CENTER POWER DISTRIBUTION SYSTEMS

GENERAL ELECTRIC

THE G-E UNIT SUBSTATION
Is the Basic Building Block of Load-center Systems



★ **Each block is a completely co-ordinated unit, as easy to specify as a standard machine tool.**

★ **Safely "at home" anywhere in the plant because of the Pyranol transformer and metal-enclosed switchgear.**

★ **Offered in flexible combinations of incoming-line and secondary-circuit arrangements, from 200 to 2000 kva.**

Metal-clad primary protection. Each high-voltage circuit is isolated in its separate, grounded, steel compartment.

Vertical-lift breakers are easily removable for inspection. For safety's sake, you can't elevate or lower breakers unless they are open.

Drawout air circuit breakers for secondary circuits are individually metal-enclosed. Breakers are interchangeable, avoiding delays during routine maintenance. Interrupting capacities are correct for the transformer ratings.

The PYRANOL* transformer section makes vaults unnecessary for indoor installation. No Pyranol transformer has ever burned or contributed to a fire.

Pressure-tight tanks protect vital parts from dust, dirt, dampness. Little or no maintenance is required.

The heat-storage capacity of the core-and-coils and of the cooling liquid makes the Pyranol transformer ideal for emergency overloads.

As an integral part of a G-E unit substation, each transformer is electrically matched with its accompanying primary and secondary switchgear.

More information in Bulletin GEA-3592. *General Electric Company, Schenectady, N. Y.*

Ask your local G-E representative about—

BUY WAR BONDS

LOAD CENTER Power Distribution Systems

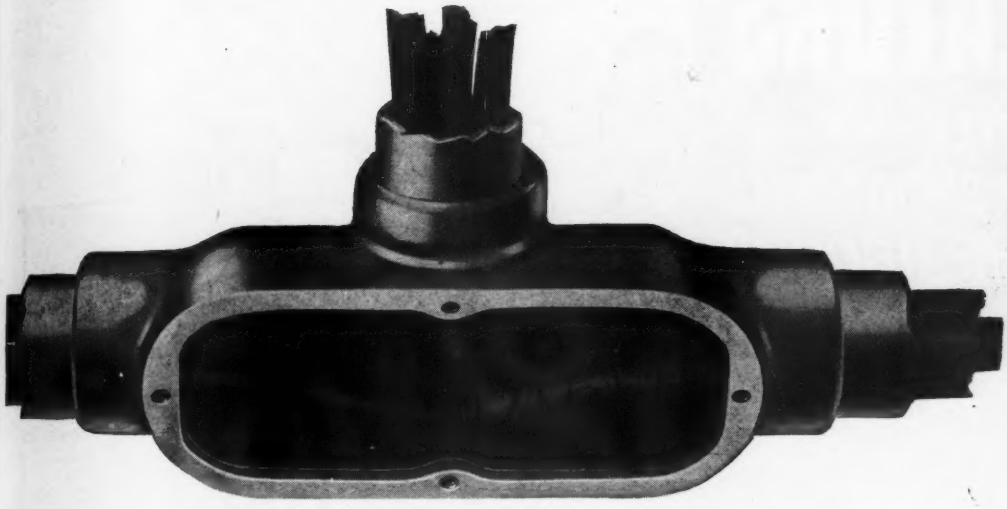
*Reg. U.S. Pat. Off.

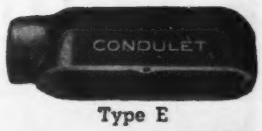
GENERAL ELECTRIC

Wherever you need **more room** for unusual splicing, tapping, or pulling requirements,

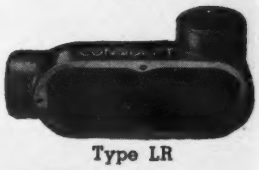
use Form 8 CONDULETS

(CONDULETS are manufactured only by CROUSE-HINDS)

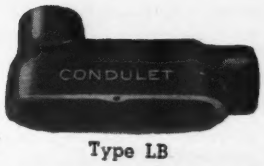




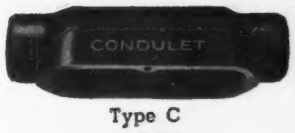
Type E


Type LR

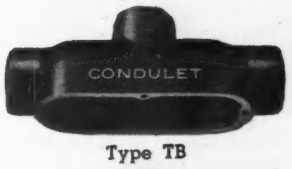
Type LL



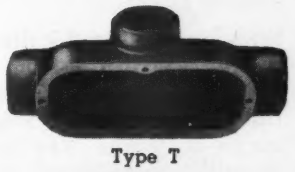
Type LB

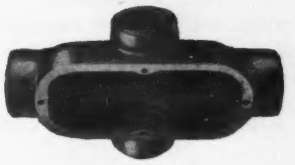


Type C



Type TB


Type T


Type X

Large wiring chamber is both wider and longer. Will accommodate more or larger conductors.

Extra wide surface for gasket between Condulet and cover.

Dome shaped blank covers in sheet steel or cast Feraloy provide extra wiring space.

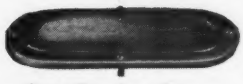
Bakelite covers, either blank or with two wire holes and three knockouts. Blank Bakelite covers may be drilled when more than five wires are required or to meet special requirements.

Sizes. Thick wall threaded 1¼" through 4" Thin wall threadless 1¼" through 2"

A Nationwide Distribution Through Electrical Wholesalers

Sheet Steel Cover

Blank Bakelite Cover


Cast Feraloy Cover

Bakelite Cover with Wire Holes

CROUSE-HINDS COMPANY
SYRACUSE 1, N. Y., U.S.A.

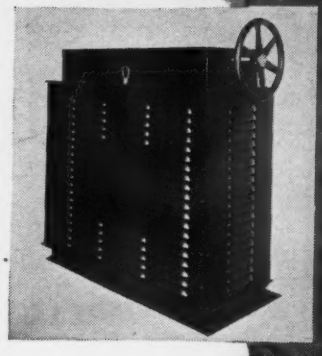
Offices: Birmingham — Boston — Chicago — Cincinnati — Cleveland — Dallas — Denver — Detroit — Houston — Indianapolis — Kansas City — Los Angeles — Milwaukee — Minneapolis — New York — Philadelphia — Pittsburgh — San Francisco — Seattle — St. Louis — Washington

Resident Product Engineers: Albany — Atlanta — Charlotte — New Orleans

CROUSE-HINDS COMPANY OF CANADA, LTD. Main Office and Plant: TORONTO, ONT.

TRANSTAT A.C. VOLTAGE REGULATORS

OFFER
Potentiometer *SMOOTHNESS*
and Transformer *EFFICIENCY*



● The Transtat Regulator illustrated was designed for loads up to 30 KVA, 50/60 cycles, single phase, input 230 volts, output 0-230 volts.

● AmerTran Transtats are air-cooled. Compact, fully enclosed for protection of operator and equipment, they present an attractive appearance. Transtats may be used for controlling electric furnaces, variable speed motors, testing equipment, etc.

The smoothness of a potentiometer without power dissipation, the efficiency of a transformer without cumbersome tap-changing; these are the advantages Transtats offer those who require either a continuously adjustable voltage or a constant voltage from a fluctuating source.

With Transtats in the circuit, there are no current interruptions, no arcing, no line surges, no power factor reduction. The velvety smooth, practically stepless control that Transtats provide may be used over a wide range of ratings. Yet Transtats are no more expensive in initial installation, power and maintenance costs than many other voltage regulating devices. Complete information covering manually operated, motorized and fully automatic Transtats available on request.

AMERICAN TRANSFORMER COMPANY, 178 Emmet St., Newark 5, N. J.

Pioneer Manufacturers of Transformers, Reactors and Rectifiers for Electronics and Power Transmission

AMERTRAN

MANUFACTURING SINCE [illegible] AT NEWARK N. J.

1919 SILVER ANNIVERSARY 1944

THE TOLEDO STANDARD COMMUTATOR COMPANY

★ ★ ★ TOLEDO • OHIO ★ ★ ★

25 years of outstanding service to electrical manufacturers and service shops made possible by energetic management. In our Toledo plant and those of our associated companies, HOMER COMMUTATOR CORPORATION and HILLSDALE COMMUTATOR COMPANY, we have the greatest commutator producing capacity in the United States. We are grateful to the thousands of customers who have made the past twenty-five years a success. We look forward to the future with pleasure—confident of our ability to completely satisfy these old customers and many new ones. We are ready at all times to consider your requirements for commutators, slip-ring assemblies, and commutator slotting and undercutting equipment.

E. D. MOON
President

COMMUTATORS
SLIP-RING ASSEMBLIES
SLOTTING AND
UNDERCUTTING SAWS
AND MACHINES

TRUMBULL

CIRCUIT BREAKERS • NO FUSE SWITCHES • MAGNETIC STARTERS IN EXPLOSION PROOF ENCLOSURES

WHERE YOU NEED THEM. These enclosures are designed to make standard Trumbull Electric Control Equipment SAFE for hazardous locations, and in atmospheres containing gasoline, petroleum, naphtha, acetone and lacquer solvent vapors, natural gas and other volatile liquids (National Electric Code Class 1—Group D also NEMA type 7).

Enclosures are precision made of cast semi-steel; covers bolted to box, metal to metal, machined matching surfaces. They are equipped with corner mounting lugs and attractively finished in machine gray enamel. Switches can be locked "on" or "off" . . . circuit breakers have front operation.

CONDENSED SPECIFICATIONS

"RBA" HEAVY DUTY INDUSTRIAL "Type A" Switches — no fuse — 30, 60 and 100 amps. — 2 and 3 pole —250V. D.C., 230-575V. A.C.

MAGNETIC STARTERS—Sizes 1, 2 and 3 — 3 pole — 110-600V.

MANUAL STARTERS—Type "TT" — Size 00; Type "RB" — Max. 2 H.P.

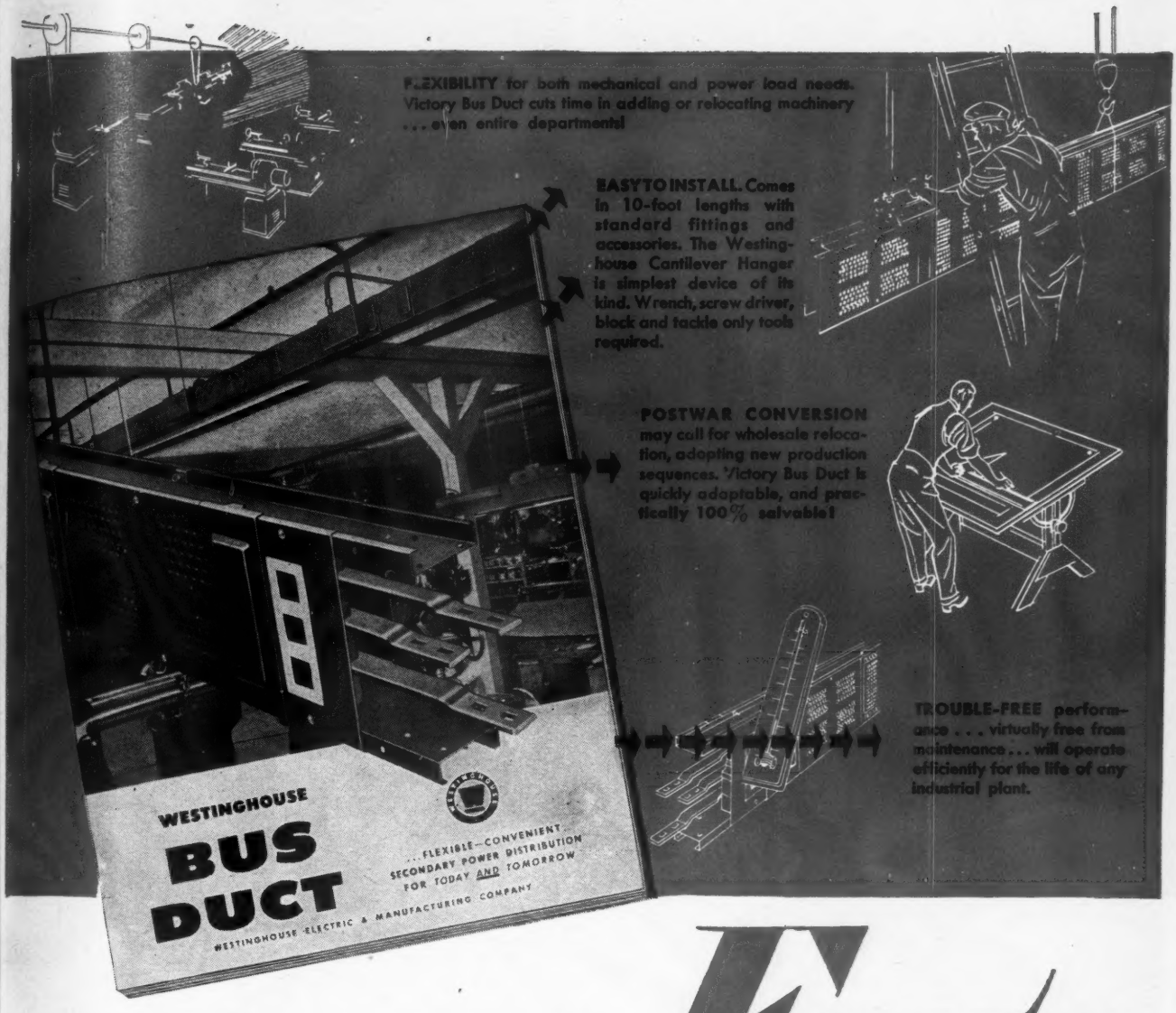
"AT" CIRCUIT BREAKERS—15 to 600 amp.—2 and 3 pole — 250V. D.C., 600V. A.C., Also 1 pole 125V. A.C. and D.C.

Trumbullaid Circular 315

TRUMBULL
ELECTRICAL CONTROL EQUIPMENT

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY • PLAINVILLE, CONN. • A GENERAL ELECTRIC ORGANIZATION

OTHER FACTORIES AT NORWOOD (CINN.) O. — SEATTLE — SAN FRANCISCO — LOS ANGELES


FLEXIBILITY for both mechanical and power load needs. Victory Bus Duct cuts time in adding or relocating machinery ... even entire departments!
EASY TO INSTALL. Comes in 10-foot lengths with standard fittings and accessories. The Westinghouse Cantilever Hanger is simplest device of its kind. Wrench, screw driver, block and tackle only tools required.
POSTWAR CONVERSION may call for wholesale relocation, adopting new production sequences. Victory Bus Duct is quickly adaptable, and practically 100% salvable!
TROUBLE-FREE performance ... virtually free from maintenance ... will operate efficiently for the life of any industrial plant.
WESTINGHOUSE
BUS DUCT
... FLEXIBLE—CONVENIENT SECONDARY POWER DISTRIBUTION FOR TODAY AND TOMORROW
WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY

YOU SHOULD HAVE THESE *Facts*

...before buying BUS DUCT

Industrial distribution systems must be flexible to meet war's constantly changing demands . . . and must fit readily into post-war conversion plans.

Westinghouse Victory Bus Duct meets both today's and tomorrow's requirements. It has many exclusive features contained in no other type of duct. A few of its outstanding advantages are listed above.

Bus Duct FACTS are contained in Bulletin 3286. This bulletin is a concise . . . complete . . . usable handbook on Bus Duct. It tells why Victory Bus Duct should be used . . . why it meets Limitation Order L-273 . . . why every rating carries complete Underwriters' approval. In addition, it gives data on plug-ins and fittings; dimension data; and specifications.

Ask your Westinghouse representative for a copy or write Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., Dept. 7-N.

J-60544

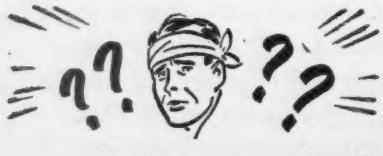
Westinghouse

PLANTS IN 25 CITIES... OFFICES EVERYWHERE

BUS DUCT

Who's going to put it all together?

THERE'S A HOUSE somewhere in that pile of clippings — in fact, several houses. That's the difficulty; can *you* sift out all those ideas, weigh their merits, and decide just which ones belong in that house you're going to build when the war's over? Better plan now to get the expert help and advice of an architect! It pays off in lasting satisfaction . . . and headaches avoided.



Sure, some mistakes can be fixed up *after* you've built, but then again, some can't. For example, you can re-hang a door that swings the wrong way, but what's to be done with cellar steps that menace the safety of the whole family? Haven't we all known of a house that looked charming in the plans, but which wouldn't accommodate the furniture? Then there's the house that's ideal in dry weather, but always has a big leaky spot on the living room ceiling when the rain blows from a certain direction. A trained mind could have forestalled all these troubles, and in addition assured the homeowner of good taste in design, adequate resale value, and low maintenance cost.

You wouldn't think of building a hospital or school without an Architect-Engineer. Your house is just as important—protect your investment by employing an architect. In most cases you save at least his fee in the many wise economies he'll suggest.

Plan your house now!
START RIGHT—
WITH AN
ARCHITECT.

EDWARDS

SINCE 1872

Communication Equipment for
Homes, Institutions and Industry

EDWARDS and COMPANY, NORWALK, CONN. • *In Canada: Edwards and Company, Ltd.*

To protect your postwar market,

Edwards and Company present the first of a series of advertisements, to appear in national magazines, designed to educate the American public to the Architect's place and function in the building of postwar homes.

HOW TO PLAN
YOUR NEW HOME
A Guide to Intelligent Building
Prepared in cooperation with the
Committee on Public Information,
THE AMERICAN INSTITUTE OF ARCHITECTS.

• Future advertisements in this series will offer a free booklet to all interested readers, pointing out the importance of the architect in intelligent building. This booklet will encourage *better living* through *better building*. It will have wide distribution through our advertising and through the architectural profession generally.

Since architect-supervised home construction will stimulate the use of adequate wiring and the installation of better equipment, the result of this long-range campaign is bound to be more business for electrical contractors, in addition gaining the good will of the architectural profession. Copies of this booklet will be gladly sent to contractors upon request.

EDWARDS AND COMPANY, NORWALK, CONN.

IN CANADA: EDWARDS AND COMPANY, LTD.

PROTECTION

WHERE THERE IS A NEED FOR FLOODLIGHTING
THERE'S A SALE FOR AUTOMATIC . . . .

Control

SANGAMO *Time* SWITCHES

• *The complete line includes* ASTRONOMIC DIAL, *Synchronous Carry-over, and Outdoor Time Switches. Every protective lighting control need can be fully met. Current interruptions up to 10 hours will not stop Form VSW2 astronomic dial time switch (shown above) nor affect its "on" and "off" settings.*

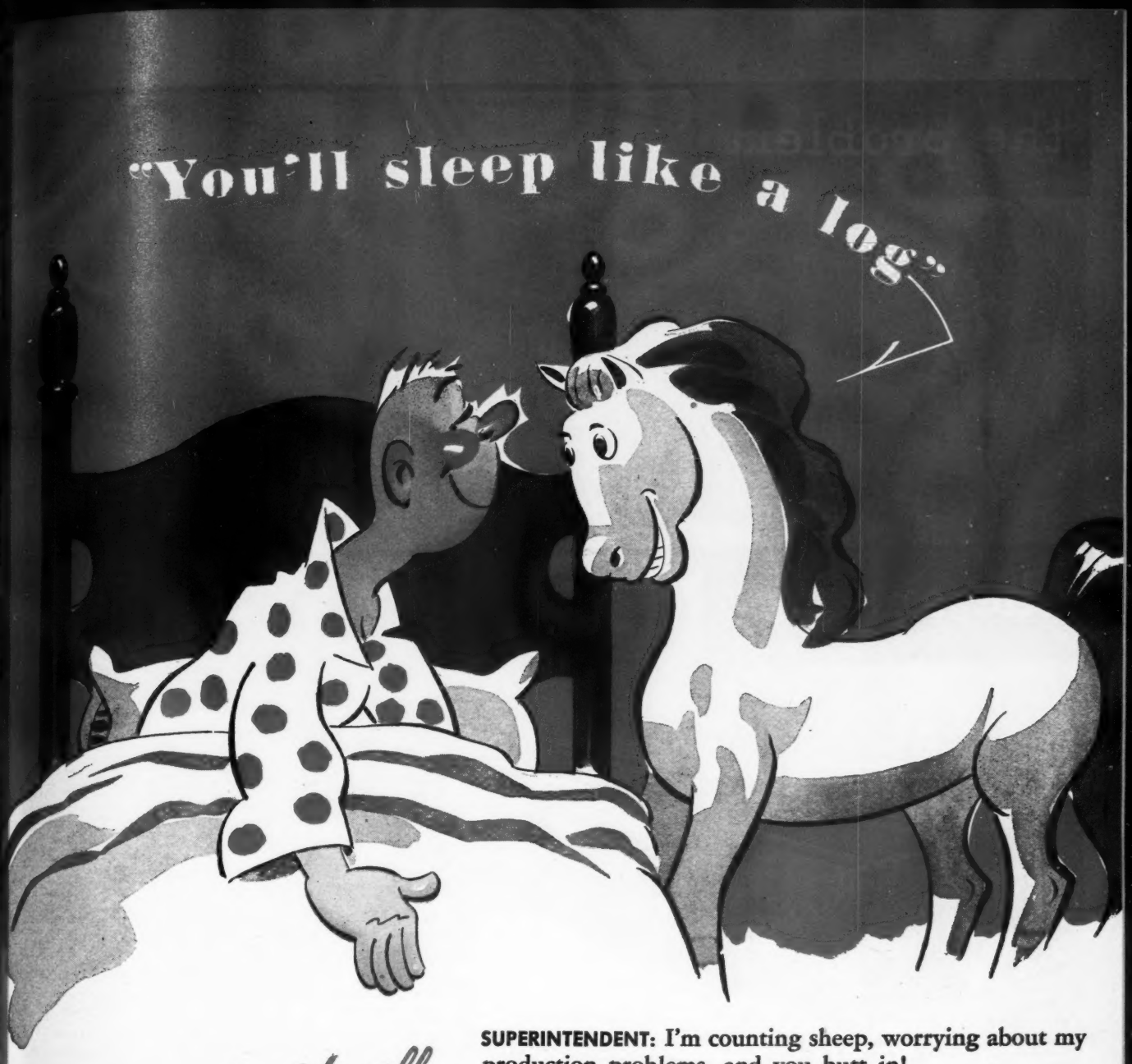
ARMY E NAVY

Full and complete protection is the thing buyers of floodlighting seek — floodlighting itself does a big job but there must be PROTECTION all the way — from the time the lights are turned "on" to the specified "off" time — there should not be the possibility of an error — that is why you see SANGAMO TIME SWITCHES on the job in so many floodlighting installations.

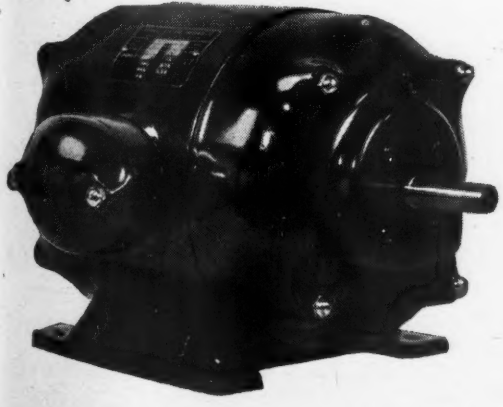
It's an easy approach for you to make — you can easily show present users of floodlighting how to insure dependable control of their lights — how to end all worry — how to do a full protective job at reasonable cost. For those new floodlighting installations, sell a modern, reliable job by including SANGAMO TIME SWITCHES.

Find out about the ease of installation—the range of application — the dependable construction — send for our latest catalog — it's valuable to you particularly NOW.

SANGAMO ELECTRIC COMPANY SPRINGFIELD ILLINOIS



Horsepower by Howell



The Howell Protected Type Motor, shown, gives complete protection against dripping liquids, metal chips and other falling particles. Completely streamlined—utilizing non-breakable steel frame—malleable or steel base—cast iron end plates and cast iron, weatherproof terminal box are standard construction features. Special horizontal and vertical mountings are available.

Available in sizes 5 H.P. and smaller.

SUPERINTENDENT: I'm counting sheep, worrying about my production problems, and you butt in!

HORSE: Super., I've got a suggestion—a hot tip—

SUPERINTENDENT: Come, come, be brief. I'm tired!

HORSE: Well, well, that's too bad. But Horsepower by Howell would put an end to all those electric motor problems in your plant. All Howell specialized motors and standard motors are engineered and precision-built for the *hard* jobs. Your jobs will be easy for these quality motors.

SUPERINTENDENT: Really? Maybe I can stop worrying.

HORSE: You bet you can! Folks quit worrying when they buy Howell Motors. They know they have a precision-built, properly insulated, quieter operating motor. With Horsepower by Howell in your plant, you'll sleep like a log.

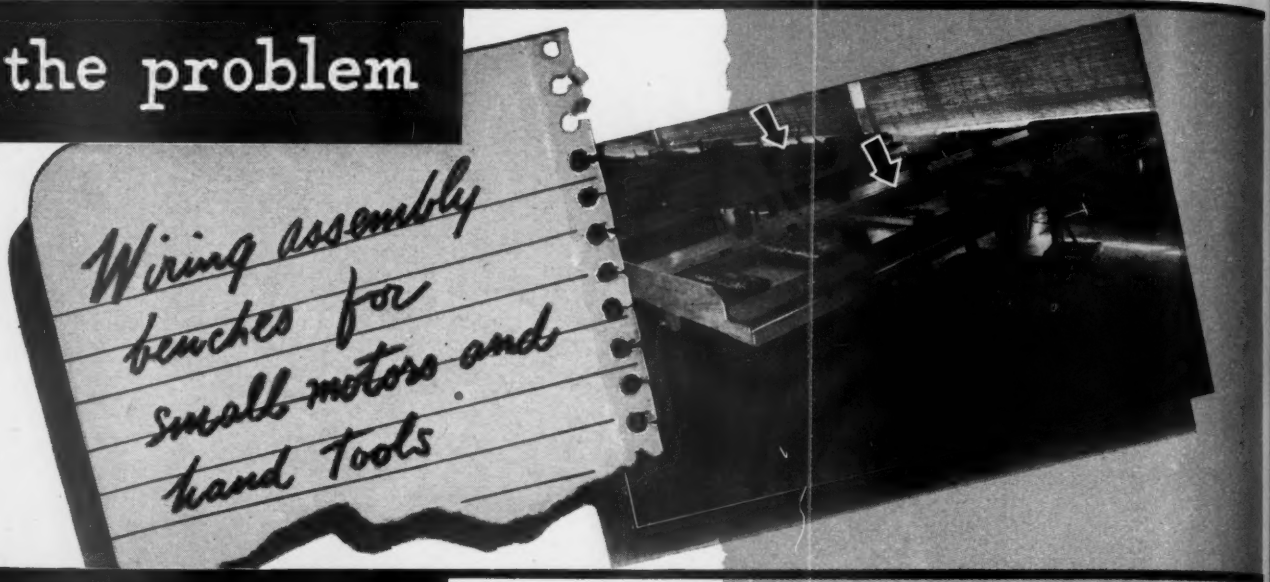
Making postwar plans? Phone the nearest Howell representative or write the factory. Your inquiry will put our experienced engineering staff and complete facilities to work for you.

HOWELL ELECTRIC MOTORS COMPANY

HOWELL, MICHIGAN

Manufacturers of Quality Motors Since 1915

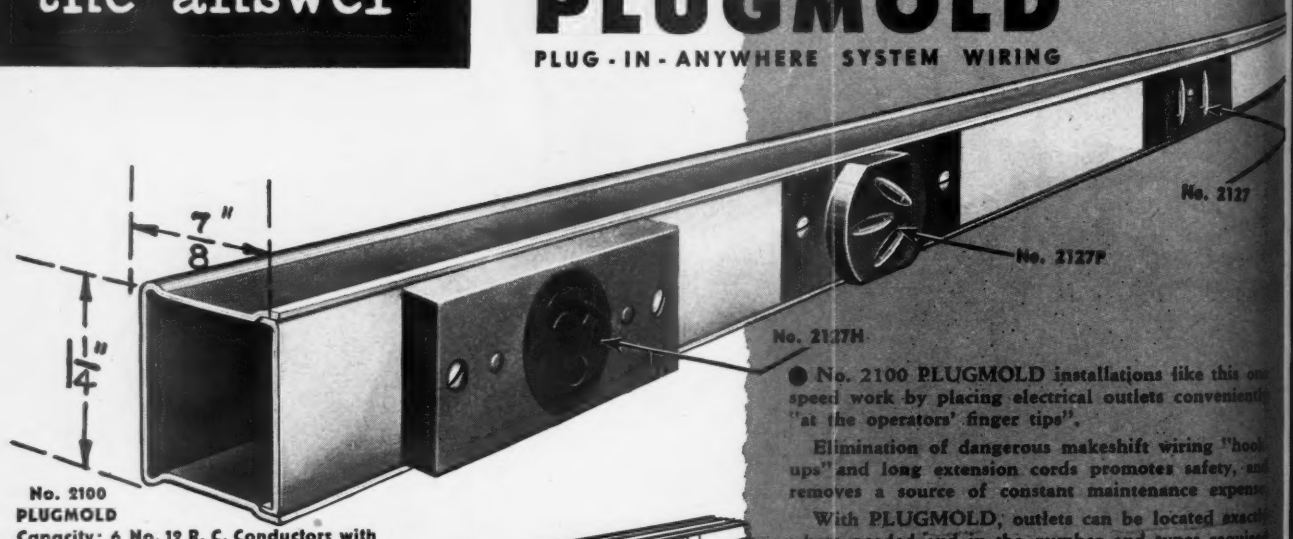
the problem



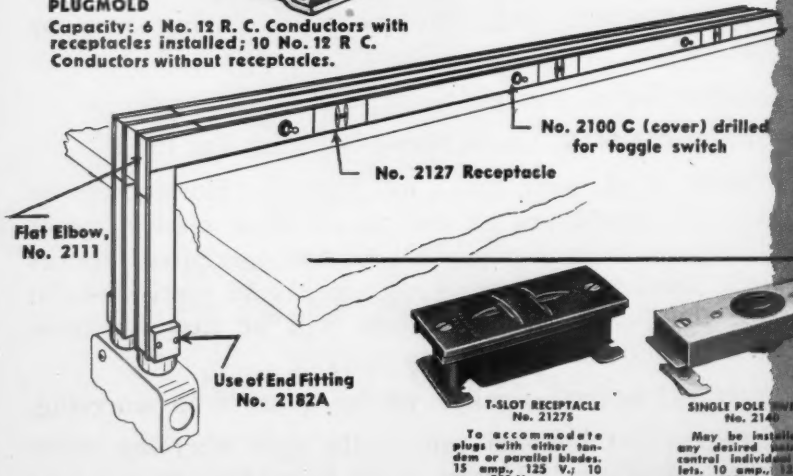
the answer

PLUGMOLD

PLUG-IN-ANYWHERE SYSTEM WIRING



No. 2100 PLUGMOLD
Capacity: 6 No. 12 R. C. Conductors with receptacles installed; 10 No. 12 R C. Conductors without receptacles.



● No. 2100 PLUGMOLD installations like this one speed work by placing electrical outlets conveniently "at the operators' finger tips".

Elimination of dangerous makeshift wiring "hook-ups" and long extension cords promotes safety, and removes a source of constant maintenance expense.

With PLUGMOLD, outlets can be located exactly where needed and in the number and types required for a specific application. Individual or group switch control may be arranged as shown.

No. 2100 PLUGMOLD Channel and Fittings are listed by Underwriters' Laboratories, Inc., and conform to Federal Specification W-R-32.

Available for immediate delivery on suitable priorities. Write for new Industrial Wiring Bulletin describing this and other Wiremold wiring systems.

T-SLOT RECEPTACLE No. 2127S
To accommodate plugs with either tandem or parallel blades. 15 amp., 125 V.; 10 amp., 250 V.

SINGLE POLE SWITCH No. 2140
May be installed at any desired point to control individual outlets. 10 amp., 125 V.; 5 amp., 250 V.

POLARIZED RECEPTACLE No. 2127P
3-wire receptacle for industrial use. 15 amp., 125 V.; 10 amp., 250 V.

MIDGET TWISTLOCK RECEPTACLE No. 2127H
2-wire, 15 amp., 125 V.; 10 amp., 250 V. with integral cover section.

WIREMOLD CAN HELP YOU PRODUCE FOR WAR . . .
WHILE YOU PLAN FOR PEACE!

KNOW YOUR
WIREMOLD
AND YOU KNOW THE ANSWERS

THE WIREMOLD COMPANY, HARTFORD 10, CONN.

How Many EYES on Your Payroll?

The eyes on your payroll are almost as important to your postwar costs, and jobs, and profits, as the men and women who own those eyes. Let's say your postwar payroll numbers a thousand. You will be paying two thousand eyes to work for you each day. But you may get the total work of only three-fourths of your "eye payroll"—fifteen hundred eyes, even though all two thousand are present on the job.

THERE'S A MAN in your town who will be glad to help you plan, now, to get a full eye's work out of every eye you hire. Let him start soon. You'll be glad you did—later.

How Your Local Utility's Engineer Can Help You Cut Postwar Costs

YOUR ELECTRIC COMPANY'S lighting engineer can prove to you that better lighting can cut your costs by getting a day's work out of every eye you hire. He's near you—he's a practical man who knows plants—and can give you practical help.

Of course his company's got "something to sell." But give them credit for selling it intelligently. For knowing how to advise you, and being well able to tell you what better lighting can do.

Roebling has something to sell, too. When Victory comes, we hope you will remember Roebling as wire specialists who are a logical source of supply for the wires and cables you'll need to modernize... with better lighting... air conditioning ... better power distribution to your plant's work... full utilization of all the electrical and electronic cost-cutters the war has evolved.

JOHN A. ROEBLING'S SONS COMPANY
TRENTON 2, NEW JERSEY
Branches and Warehouses in Principal Cities

JAR ROEBLING

ROEBLING
PACEMAKER IN WIRE PRODUCTS

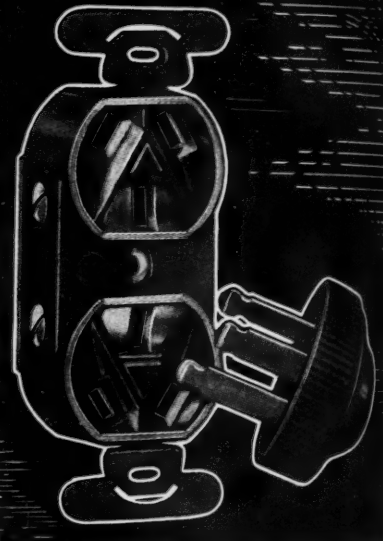
Wire Rope and Strand • Fittings • Cold Rolled Strip • Aircord, Swaged Terminals and Assemblies • Round and Shaped Wire Wire Cloth and Netting • High and Low Carbon Acid and Basic Open Hearth Steels Suspension Bridges and Cables • Electrical Wires and Cables • Aerial Wire Rope Systems

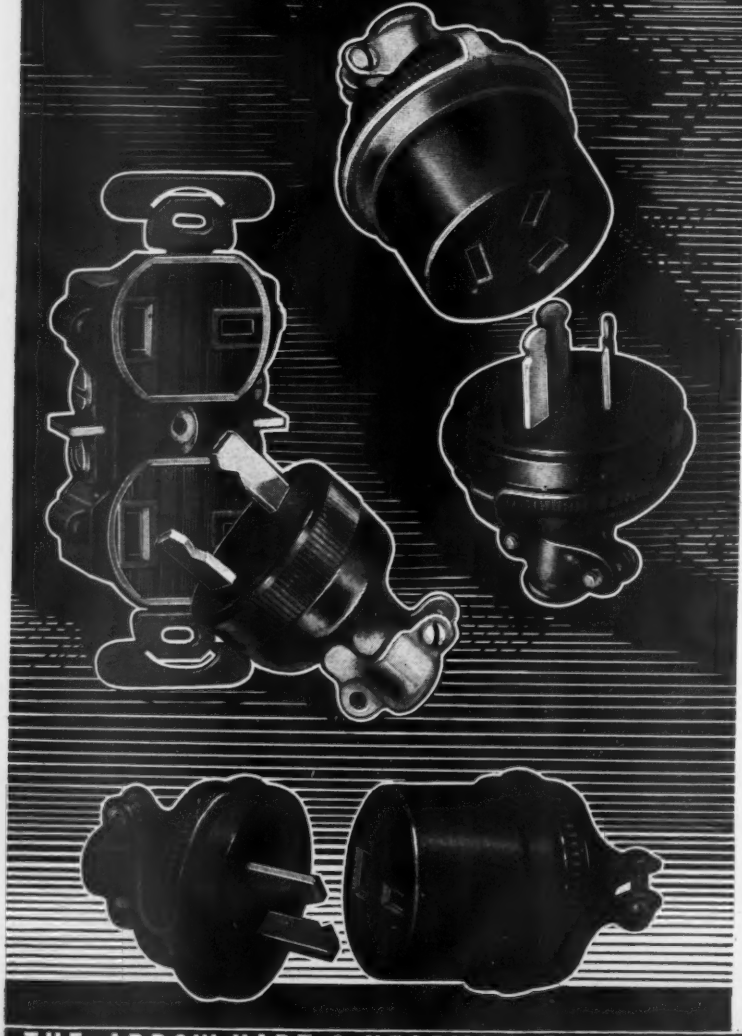
REMINDING INDUSTRY of the advantages of postwar electrical modernization, with Better Lighting, Air Conditioning, Full Utilization of War-Developed Electrical and Electronic Devices . . . this Roebling campaign will aid Electrical Contractors.

POLARIZED ARROW

RECEPTACLES

PLUGS and CONNECTORS





Give the workers in war-driven plants a wider range of usefulness. Extend the *reach* of their power tools. Install more *OUTLETS* for handy connections with portable drills, grinders, riveters, saws, melting pots, light machines — in just the locations to speed up production or assembling.

These Polarized Receptacles, Plugs and Connectors dependably *energize* new operations for which present wiring facilities may be inadequate. The line includes two, three and four-wire devices in 10, 20, 30 and 50 Ampere capacity. Pictured here are a few of the more popular types, available on priorities. More specialized needs are provided for also in rugged, reliable constructions.

DISTRIBUTED THROUGH ELECTRICAL WHOLESALERS

ARROW ELECTRIC DIVISION

THE ARROW-HART & HEGEMAN ELECTRIC COMPANY, HARTFORD, CONN., U.S.A.

"OR EQUAL" OR WORSE

Leading architects are meeting with building material manufacturers in an attempt to eliminate the "or equal" clause of specifications. They believe that if this clause is cut out, and only one manufacturers' product is approved specifically and by name, the substitution problem will be licked.

Substitution is a problem, and a serious one to our industry. But dropping out the "or equal" clause will accomplish exactly nothing. It could have undesirable economic effects—but that is another story. The trouble is not one of words.

The real trouble is no farther away than the offices of the architects. Speaking only of electrical work, and putting first things first, too many specs are sloppily written by men who are not electrical experts. By their very nature, such documents are full of holes, both ethically and legally.

Second, architect's methods of job inspection are often superficial insofar as the mechanical trades are concerned. Sub-standard materials would never be installed if their inspectors knew, and did, their jobs. With effective inspection, unauthorized substitution is virtually impossible. With casual, inexpert inspection, substitution will occur regardless of whether "or equal" clauses are in, or are not in, specifications. And practically every specification contains a paragraph which requires the architect's written approval of any products which the contractor wishes to use in place of those originally named. Unapproved substitution is directly the fault of inadequate architectural supervision and contract enforcement.

Third, bidding methods in the building trades favor the cut-price sub-contractor. In all too many cases, architects let jobs to general contractors who, in turn, sublet the electrical work. The majority of these generals are only brokers. They have little or no knowledge of the mechanical trades. Their sole interest is to place this portion of the job at the lowest possible price. In plain words, they chisel the sub. Despite these tactics, most electrical contractors are ethical enough to live up to the letter and the spirit of the specifications. Owner and architect get a far better job than they deserve—at the expense of the trade.

These, if you please, are the real reasons why specifications are sabotaged. Electrical contractors take pride in fine workmanship; they would rather buy good than inferior materials, if only because they have to guarantee the jobs they do. They know what steps should be taken to solve the problems we have outlined. Here are the solutions:

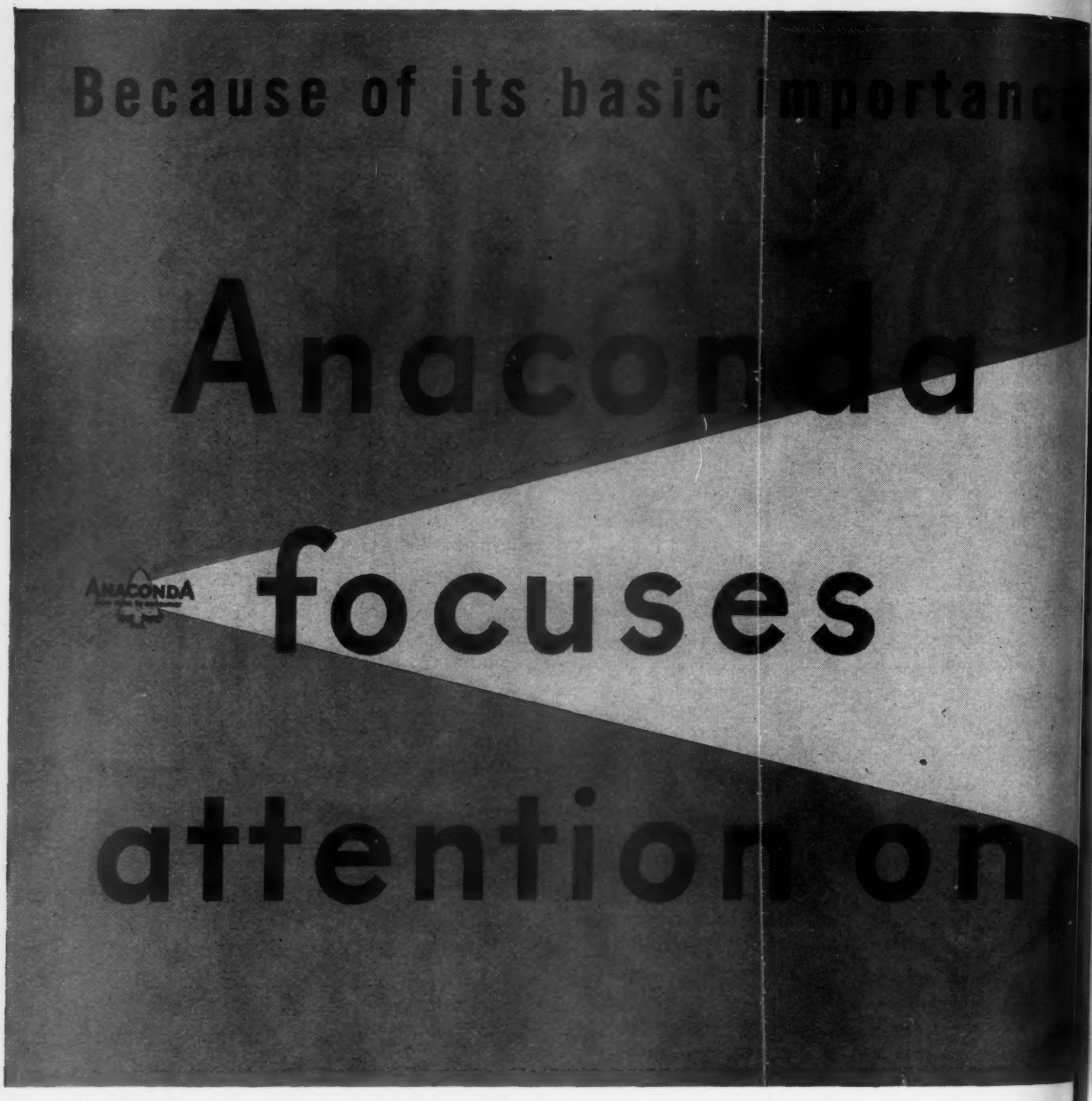
1. Architects must write clear, technically accurate specifications, and prepare adequate plans.

2. Architects must employ job inspectors who are competent to pass upon all phases of mechanical work. Their inspections must be frequent and thorough.

3. Architects must let all mechanical contracts direct. They must restrict the bidders' lists to contractors who are both financially and technically qualified to do a given job—and *who have a reputation for living up to specification quality standards.* There are such contractors in every community, and it is part of an architect's job to know who they are.

We hope architects are not so naive as to think that by changing a word or two in their specifications they will relieve themselves of the responsibility for clear specification writing or expert judgment of comparable quality. And without "or equal" stated or clearly implied the architect becomes the agent of the manufacturer, a relationship nobody wants and one which, at best, is professionally dubious.

Wm. F. Stuart



Nothing is more basic in furthering the interests of the electrical industry as a whole—and of each individual branch—than the promotion of electrical wiring. This has long been the number one belief with Anaconda Wire & Cable Company.

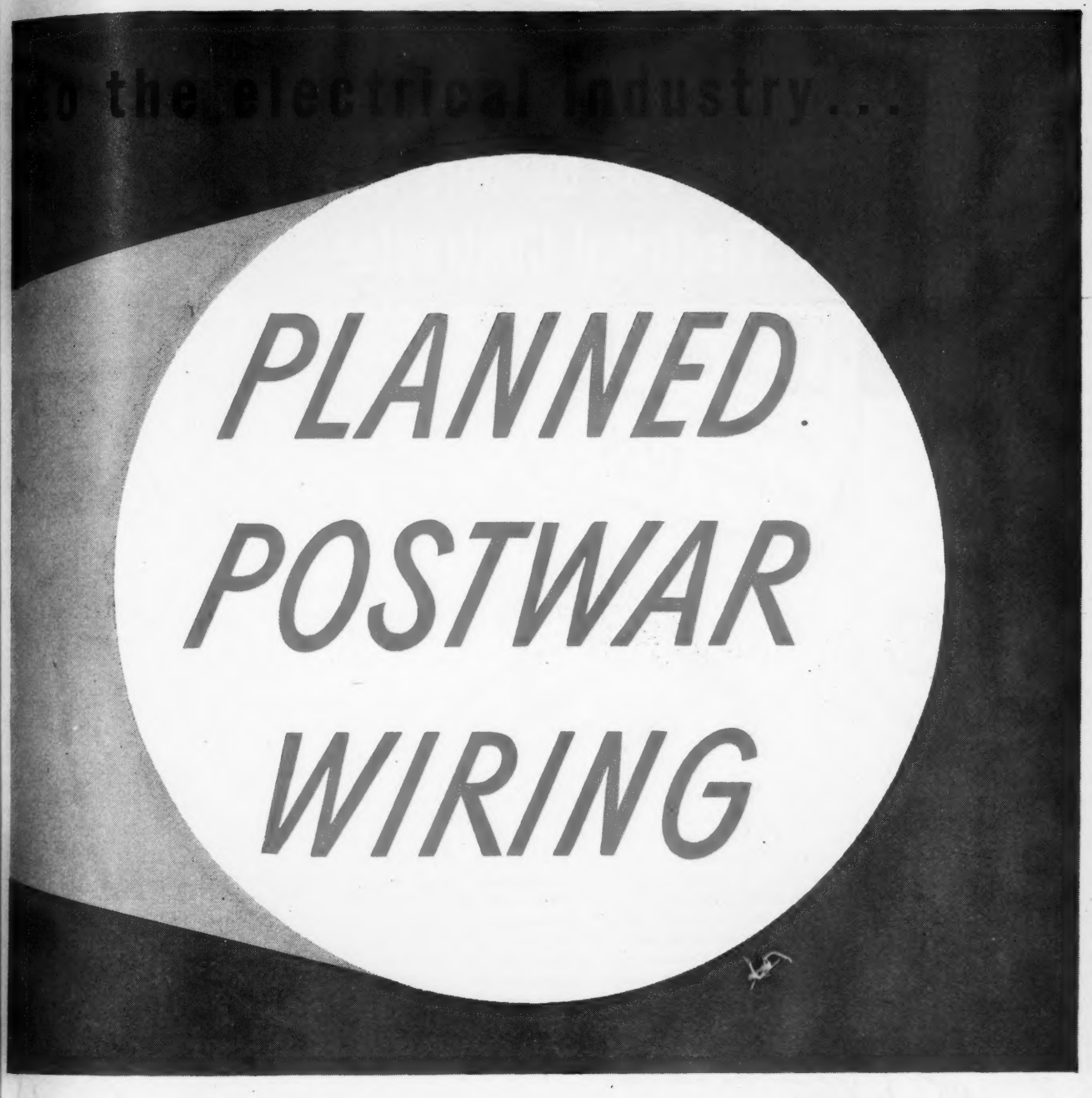
THE PAST

You probably recall the "Electrical Modernization" campaign of Anaconda prior to the war. It helped stimulate national interest in better wiring for Industry and helped to prepare Industry to meet the challenge of war production.

THE PRESENT

A more recent example is the "Preventive Maintenance" campaign developed by Anaconda engineers to meet wartime conditions. Based upon practical methods of conserving electrical circuits and equipment, it is being widely used.

Electrical Wires and Cables of Copper are the Life Lines



THE FUTURE

Today, the time is ripe for another step forward in furthering adequate wiring. We believe we can render a constructive service to the electrical industry and to business in general through a national campaign promoting the importance of *postwar* wiring.

Its objective will be to stimulate *advance thinking* about adequate wiring...to drive home to industry, municipalities and home owners the vital necessity of including PLANNED WIRING IN EVERY POSTWAR PLAN!

THE IMPORTANCE

Obviously, more and better wiring will have to come *ahead* of tomorrow's more efficient industrial production . . . city improvements . . . new products . . . finer appliances . . . more livable homes. The wider the recognition of this, the better business for everyone . . . utility, contractor, wholesaler, manufacturer.

And now—in advance—is the time to lay the foundations. Postwar planning is gathering momentum. *Unwired* planning will benefit no one. *Planned wiring* will help everyone. 44227

of our Nation

ANACONDA

ANACONDA WIRE & CABLE COMPANY

25 Broadway, New York 4 . . . Sales Offices in Principal Cities

HERE'S what we're telling architects and builders about you ...Mr. Electrical Contractor

Because there's a Manpower Problem at every TURN
Be Sure to "TALK TOOLS" with
JOHN WATTS
Electrical Contractor
● IT'S JUST A TWIST of the wrist to the draftsman, but that curve in the entrance conduit can start the man-hours climbing and the work-schedule falling—if you overlook the importance of tools to modern electrical installation work.
Actually, the pipe bending method shown is completely obsolete with the well-equipped electrical contractor. One GRAYBAR customer, for example, has four hydraulic bending machines plus a specially designed unit of his own which will handle 4-in. conduit with ease.
Electric welders, pipe threading machines, metal cutting bandsaws, mobile elevator scaffolds . . . these are some of the tools that now regularly augment the pliers and the screwdriver, and the latter may be electric driven! JOHN WATTS has grown up with electrical construction.
Whether your plans cover a big public works project or just a few simple homes, it will always pay you to talk tools and installation techniques with an electrical specialist like JOHN WATTS. And all over the country, you'll find well-equipped electrical contractors keeping themselves well-equipped . . . via GRAYBAR.
Specialty built pipe bender
"Mobiladder" Scaffold
Give Your Electrical Work to "John Watts"
a qualified electrical contractor—leading a well-established firm with the trained organization, tools and know-how to give you specialized assistance on wiring, lighting, signaling, power supply, electronics. From offices and warehouses in over 60 cities, GRAYBAR serves a nation of JOHN WATTS, helping them to help you by supplying the newest and best in electrical materials.
GraybaR
Executive Offices: Graybar Building, New York 17, N. Y.

Modern methods

Well equipped

Recognition for your tool equipment

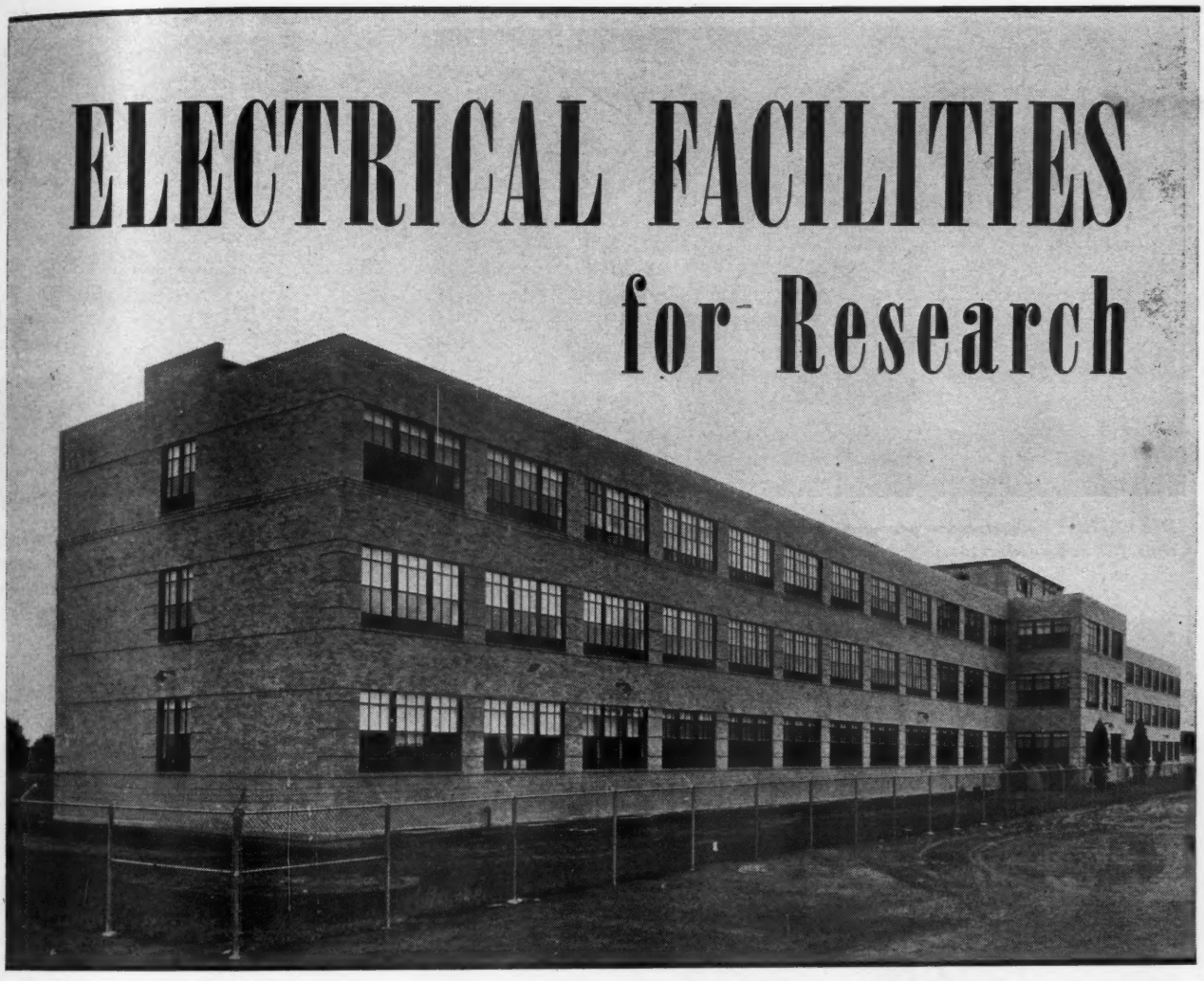
Support for you

Electrical specialist

Your Qualifications

This is one of a series of advertisements appearing in "Architectural Forum", carrying the story of contractor service to 100,000 readers—the men whose decisions mean the most to you in present and post-war building. 98

ELECTRICAL FACILITIES for Research



LABORATORIES of RCA. Area lighting units around the building are 300-watt lamps in asymmetric prismatic globes.

THE electrical installation at the new RCA Laboratories in Princeton, N. J. is one of the most interesting encountered in recent months. It was designed by The H. K. Ferguson Company, engineers and builders, and installed by A. Neri, of Hoboken, N. J.

RCA Laboratories are the world's largest for radio research. They explore not only radio but electronics, sound acoustics, chemistry, physics, mechanics, optics, cathode ray tubes, fluorescent materials, lenses and photography. All are allied with radio development, and facilities adequate to enable scientists to study them were provided in the design and construction program for the new building.

It was, therefore, necessary to design an electrical system that filled the requirements for a wide variety of needs. It was necessary to supply electrical energy in many different voltages, phases and frequencies throughout 150 laboratory bays to 420 workbenches.

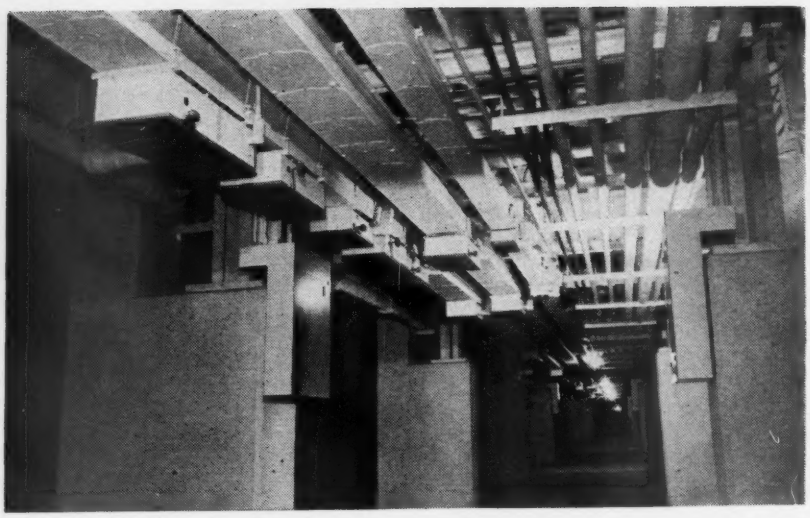
Laboratory wiring, where ample capacity, safety, flexibility and convenience are essentials often point the trends of wiring development. RCA's new lab at Princeton uses bus-duct feeders and outlet troughs of special design.

The primary electric service for the laboratories is 4160 volts, 3 phase, 3-wire, 60 cycles. It is brought in underground to a main substation in the basement of the three-story laboratories building where a 1000 kva. transformer bank steps down to 120–208 volts, 3 phase, 4 wire for general power and light distribution throughout the laboratories and model shop, the latter a one-story factory-type structure adjoining the main building.

Special voltages and frequencies, both a.c. and d.c., regulated and unregulated, for the major part of the laboratory requirements, are provided by motor generator sets and induction regulators located in the basement substation. Other special voltages and frequencies required in small amounts at various places are provided by portable equipment.

Power and light services for the laboratories are distributed longitudinally through the corridor in the basement by plug-in bus-ducts with branch circuits rising vertically in service ducts adjacent to the corridor at each column, to the individual laboratories on all floors.

Power services for the individual laboratory rooms are run from the vertical service ducts to one or more master control panels in each room. The master control panels are adjacent to the service ducts and directly above the special service outlet troughs mounted over the laboratory benches. They control the feeders to the service



***DISTRIBUTION** circuits are enclosed busbars with disconnecting plug-in taps for sub-feeders.*

***CEILING MOUNTED** 120-watt fixtures on 18-foot centers light the 488 foot corridors into which 150 laboratory bays open.*

***SHOP EQUIPMENT** is connected by flexible cable to special outlets. Fluorescent lighting units are suspended at 9 feet, 11 inches on messenger wire.*

***BENCH OUTLETS** are intricate wiring troughs with special cover plates providing connections for a.c., d.c. and special circuits. Main*

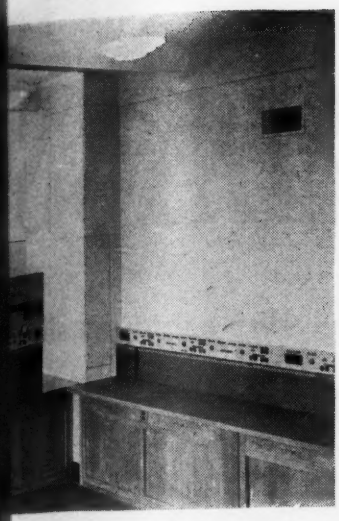
troughs and also the branch feeders to other isolated outlets in the room.

Special electric service outlet troughs for the laboratory benches were designed by Ferguson and RCA engineers to give the maximum number of outlets in a flexible arrangement that would meet the great variety of requirements for electrical services on the benches. The service troughs consist of sheet steel raceways six inches high, three inches deep and six feet long to correspond with the unit bench length. The outlets were arranged in special interchangeable gang plates and installed in front of the raceways in three basic arrangements of 31, 33 and 35 outlets that provide either 10 or 11 varieties of voltages, phases and frequencies for each six-foot bench. The number of outlets in the gang plates varies from one to six, depending upon the type and rating of the outlets. The six gang plates are provided with individual control switches. Service troughs are mounted one foot above the back of the benches and are either mounted singly or are coupled end to end to suit arrangements of two or more benches.

Power and light services for the model shop building are distributed over head in the trusses by plug-in busducts with radial branch feeders.

Lighting branch circuits are distributed in the same general manner as the power circuits. All panels for the laboratory building are located in the basement, with the exception of panels for corridor and exterior lights which are at the guard station.

Incandescent lighting is used



switches are at the end above the trough. An exposed grounding bus runs under the outlets. Lighting fixtures are open 500-watt.

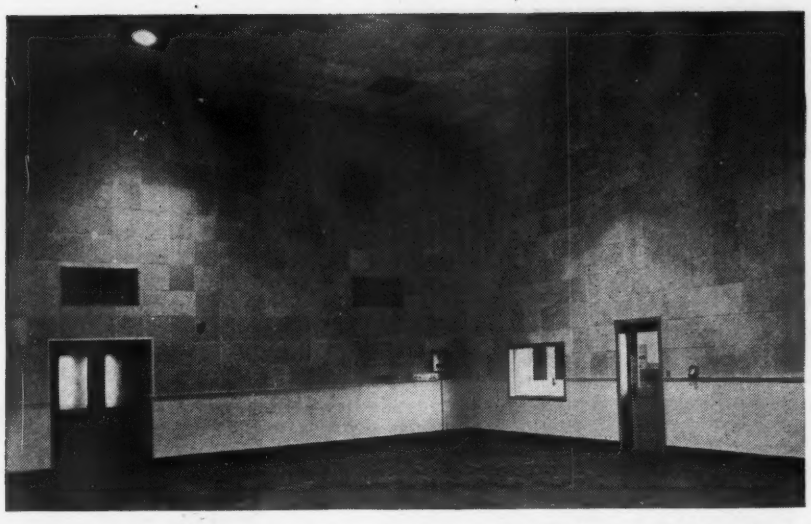
throughout the main laboratories building. Totally indirect fixtures are used generally, with the fixtures well shielded in the ceiling panels between the beams. These fixtures provide an initial illumination of 35 foot-candles.

Special lighting problems were encountered in numerous places, among them a two-story television studio, a three-story free field sound room, electrically shielded cages and air conditioned laboratories. In each case the lighting was designed to meet the requirements of the application.

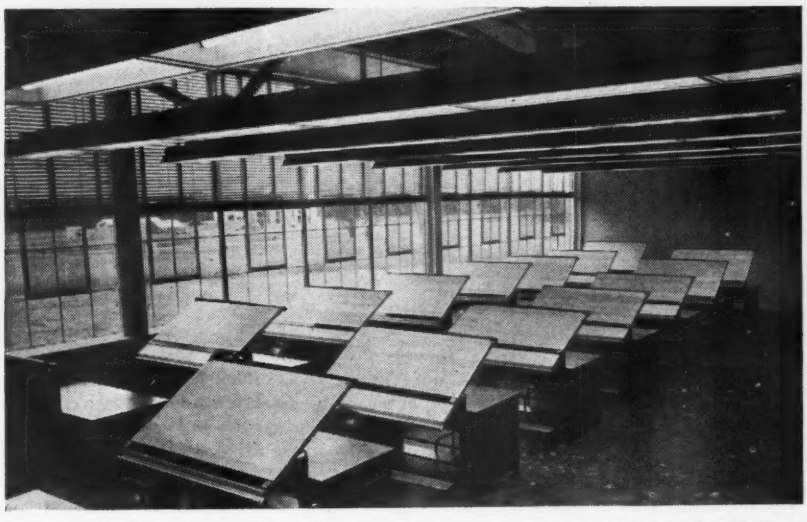
Fluorescent lighting is used throughout the model shop to provide initial illumination intensities of 70 foot-candles for the drafting room, 65 foot-candles for the machine shop, 55 foot-candles for the woodworking shop, and 35 to 50 foot-candles for other work areas. All fluorescent fixtures in this section were provided with inductive-capacitor filters to eliminate radio interference in the laboratory building.

The electric service for the boiler house and several other small isolated buildings is a 4160 volt feeder from the main substation in the laboratories building to a small substation at the boiler house where transformers step down to 440 volts, 3 phase, 3 wire for distribution. Local dry type transformers supply lighting services.

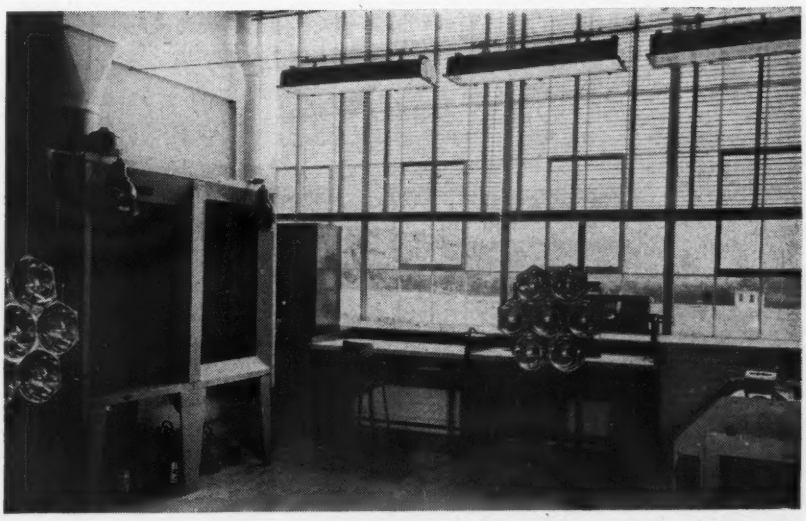
A complete underfloor duct system with separate ducts for telephone circuits and for special intercommunication and signal circuits was installed. In addition to this duct system, a complete system of empty conduits was provided in the floors of all rooms for future new circuits.



***TELEVISION** laboratory has a typical set of bench outlets in far corner and 500-watt lighting fixtures with concentric louvers set flush.*



***DRAFTING ROOM** lighting in 8 continuous rows of two 40-watt industrial type fluorescent fixtures, with six units to a row and the rows spaced six feet between centers. Four No. 10 wire circuits feed the group.*



***LACQUER ROOM** has portable banks of near infra-red lamps for quick drying and rows of vapor-proof fluorescent lighting on 10-foot centers suspended from messenger wire.*

GLASS

How a midwest shop

JACK GILES **has won confidence and increased profits through a campaign for high quality rewinds.**

REWINDING ARMATURE **of 3 hp. 2400 rpm motor with glass insulated magnet wire. Slot insulation is 10 mil mica-glass combination with a 10 mil varnished glass cloth liner and asbestos tape pads under ends of turns.**

BILL and Jack Giles have built up one of the most successful repair shops in the Middle West on a simple policy, "The better quality materials we use, the better our workmanship; and the sounder our service policy, the more business we will have." Their repair shop, at Marion, Ill., in the heart of the Southern Illinois coal field, has grown larger each year. Their operations have expanded year after year, covering a larger territory. And their business is a mutually profitable one, for their customers are getting the best for their money with a comfortable margin of profit for the repair shop. And, today, the Giles Armature and Electric Works have most of the mine motor repair business of the area. To obtain this growth, the Giles have continually adopted new materials, and improved the quality of their work to match the new developments of electrical manufacturers. Their shop, employing today about thirty men and women, is filled with modern equipment and special fixtures designed to do each job quicker and better.

After a slow and steady growth, in which they built up customer acceptance, Bill and Jack decided to swing as many of their customers as possible over from double cotton insulated jobs to asbestos insulation. The improvement in life in most cases was considerable. Their reputation grew, and they increased the number of their customers. They are willing and anxious to try anything new, give it a real test in operation, even if they have to stand the increased cost themselves on the experimental jobs. As a result, when glass electrical insulation came along in 1937, they were quick to accept it as a new material which might give their customers longer-lasting rewind jobs.

Their first rewind job with glass insulation was on a 2 hp. coal conveyor motor. The motor was often stalled, operated in wet coal seams, and was generally overloaded. The average life of this type of motor, under the conditions of service, was about nine months, with a maximum life of about 11 months. Their first glass rewind job ran for more than three years without failure and, according to Jack Giles, it may be running yet, for the particular mine where this motor was used was closed down, and all the equipment transferred to another field.

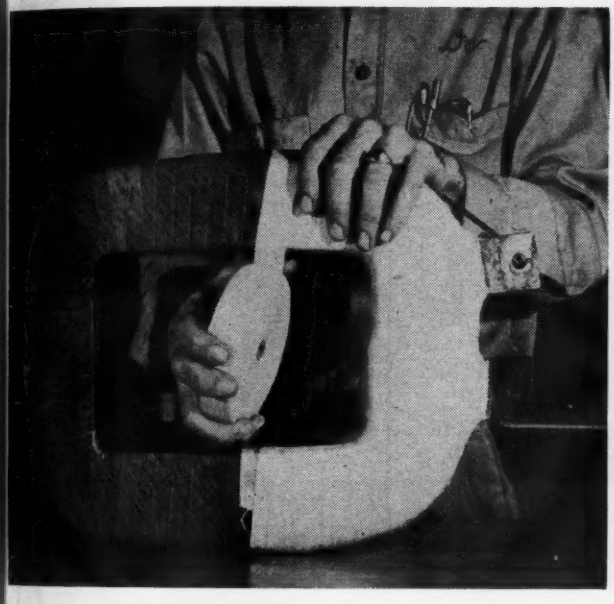
After this first small experimental job, glass was used in progressively larger equipment. The first big job that Giles used glass on was in the latter part of 1937. It was an armature used in a 10-ton mine locomotive which is usually overloaded considerably. As a result of this overload, the armatures had an average life of about a year with some jobs lasting about fifteen months. One of the larger coal mines in the area had five of these mine locomotives in service. At that time the Giles brothers had not had any business from this company, and were anxious to get a start with them. To get this start, they quoted on using glass insulation instead of cotton or asbestos on the rewind of two armatures. The price was $210 apiece, while the usual highly competitive price with cotton was $125. However, they used the plus value of glass and its higer price as selling features, and they were given these two trial jobs. These two armatures are still running, after six years of continuous operation.

Needless to say, the Giles shop is now getting most of the business from the coal company. Jack Giles says the

[Continued on Page 85]

REWINDS build profits

specialized on glass rewinds to build new business, and a reputation for quality.

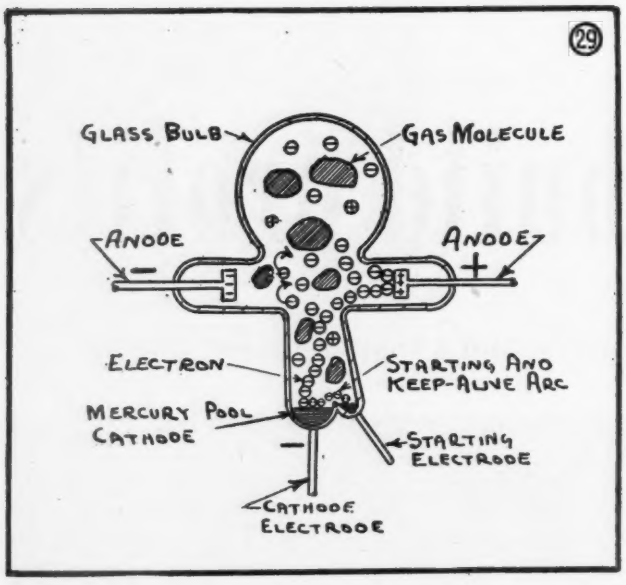


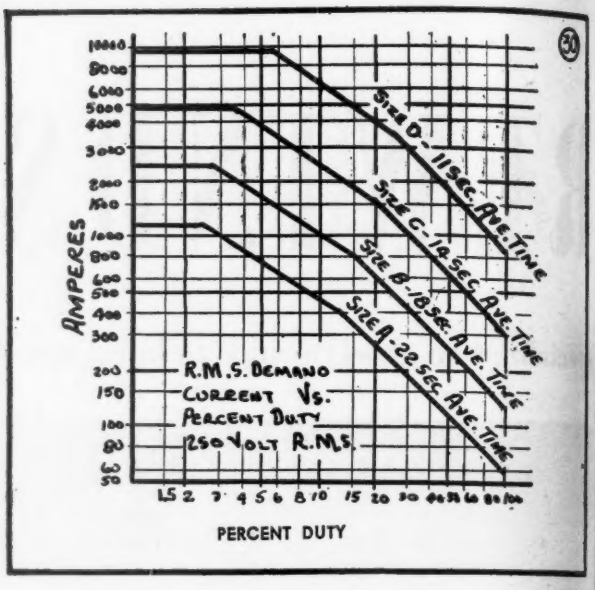
HEAVY 25-mil staple glass tape is used as a protective wrapper on this compound field coil for a 35 hp. Joy Loading machine. Coil is made of single cotton covered wire and rap of bias varnished cambric tape.

GLASS TYING cord is used for the string band and for tying down the V-ring. The Giles Works use glass cord on nearly all of their jobs as insurance against failure by arc-overs on coal dust.

TAPING COILS FOR a 300 kw. rotary converter. Over the double glass covered magnet wire, a mica cell of fishpaper and amber mica is wrapped and then covered with ¾-in. by .005 glass tape. Paper cup in foreground holds a special sticker used to keep glass in place at beginning. Piece of rubber inner tube is used to tighten and smooth off glass taping as work progresses.

PLACING COILS in the slots of the armature of a 6-ton haulage locomotive. Single saturated glass sleeving is used as lead insulation on all glass jobs because the time of application is reduced in comparison to use of untreated sleeving. .



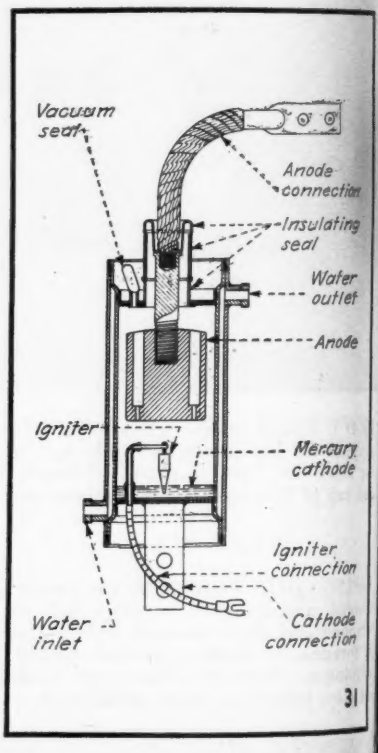

30
AMPERES
SIZE D - 11 SEC. AVE. TIME
SIZE C - 14 SEC. AVE. TIME
SIZE B - 18 SEC. AVE. TIME
SIZE A - 22 SEC. AVE. TIME
R.M.S. DEMAND CURRENT VS. PERCENT DUTY
250 VOLT R.M.S.
PERCENT DUTY

Fundamentals of Electronic Tubes

No. 4

Mercury pool tubes carrying heavy currents are described in this article, the fourth in a series.

By Ralph B. Immel,
Control Engineer
Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.



FOR many applications where it is desirable to use an electronic tube capable of delivering a very large value of current or when a tube is needed for controlling a high surge current for a very short duration of time, it is very economical and practical to use a tube with a mercury pool cathode.

5. *Mercury Pool Cathode Tubes*

A filament or oxide coated cathode element in a thermionic emission type of tube cannot withstand currents in excess of the heater capacity, and in order to deliver high currents, an impracticably large cathode must be continuously operated at a high operating temperature. A mercury pool cathode can provide a practically unlimited supply of electrons and is widely used in tubes for a.c. power conversion and current control in spot and seam welding applications.

A. *Mercury Arc Rectifier*

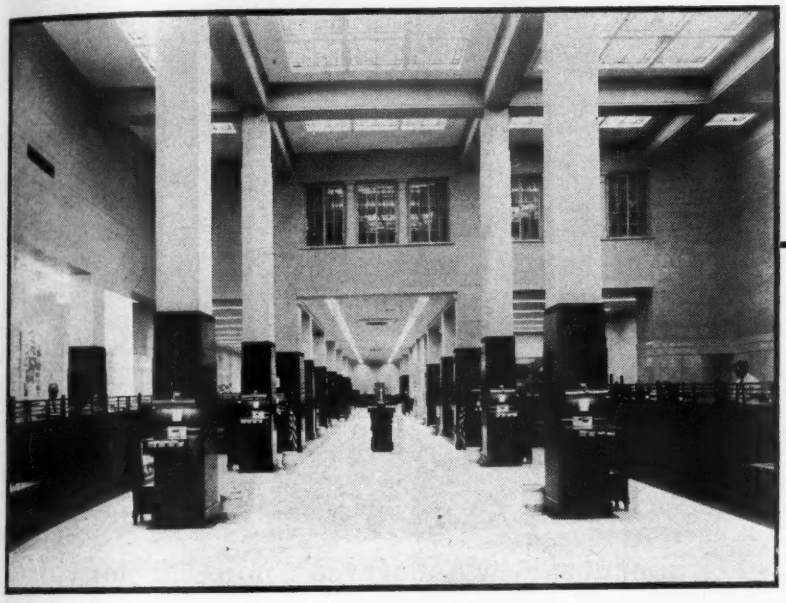
Fig. 29 shows a typical mercury arc rectifier tube. In order to start the arc and conduction of current from the mercury pool cathode to the anode, the tube or bulb must be tilted until contact is made between the two mercury pools. Then, when the tube is returned to its normal position, an arc will be drawn on the separation of the two mercury pools. The arc consists of electrons and ions which are rapidly diffused throughout the tube. The mercury vapor in the tube will glow and current can be conducted from a cathode spot on the mercury pool to the anodes similar to the operation of the vacuum or gaseous tube.

The cathode spot or place where the electron current stream leaves the mercury pool functions the same as a filament or cathode in a vacuum or gaseous tube; however it provides an almost unlimited electron emission capacity. The arc can also be started by withdrawing a current conducting ignition rod from the pool. However, with either starting method a keep-alive-arc must be provided to maintain the arc.

After the arc has once been initiated, additional electrons will be freed and positive ions created by the collisions between the electrons and the gas molecules. Bombardment of the mer-

[Continued on page 108]

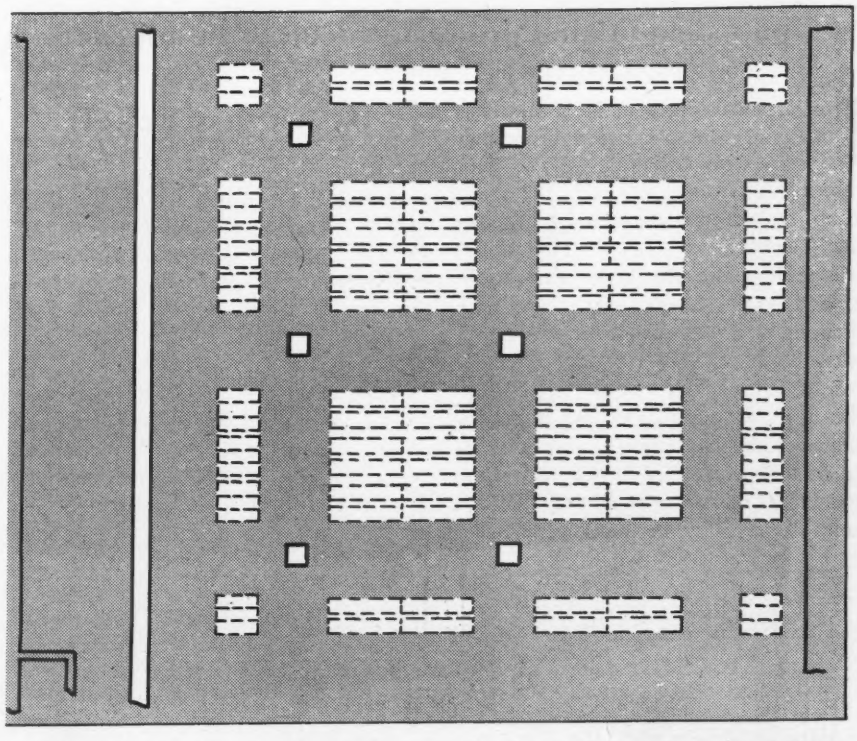
FLUORESCENTS Reduce Accounting Errors



Conversion to fluorescents has permitted doubling foot-candles with elmination of glare.

***THE MAIN BANKING** room is canopied by a skylight flooded with fluorescent illumination. Foot-candle meters measure a maintained intensity of 50 ft.c. The main public aisle and the open side offices are lighted by a right angle pattern of flush troffers.*

***PLAN VIEW** showing layout of skylight fixtures. The units are mounted three feet above the glass. Large fixtures are two-lamp 100-watt units and small ones are two-lamp 30-watt units.*



AN increase of lighting levels from 20 and 25 foot-candles to 45 and 50 foot-candles has reduced errors considerably in the American Trust Company, Charlotte, N. C.

The fluorescent installation was made by Robinson Electric Company, lighting engineers and contractors, and Roy Robinson, vice-president and engineer of that concern reported that much favorable comment has come from both employees and clientele, and that Trust Company officials are further pleased by the reduction in errors brought about by the new installation.

The artificial skylights in the ceiling of the main banking section furnish eye-level illumination of 50 foot-candles maintained. Initial illumination was approximately 65 foot-candles. The four large center sections are each furnished with 12 two-100 watt units mounted three feet above the skylight glass. The glass is flush with the 30-foot ceiling. The four end sections are each furnished with four 2-100 watt units at the same mounting height. The side panels are similarly equipped with a total of 48 two-30 watt units. The complete load is phased out to give properly balanced three phase operation and each fixture is equipped with two-lamp ballasts.

The original skylight installation was furnished with banks of 200-watt incandescent units which provided a maintained average illumination in this section between 18 and 20 foot-candles.

Further back, on the ground floor, the main public aisle is lighted with two continuous strips of flush-mounted troffers accommodating single-lamp 100 watt tubes. Alternate fixtures were supplied with two-lamp ballasts to

[Continued on page 108]

Breaking P

INSTRUMENTS USED included a graphic wattmeter with current transformers, a voltmeter, and a clip-on type ammeter.

How an electrical contractor's instrument survey uncovered a power factor bottleneck in a midwest machine tool plant. Corrective measures permitted additional productive load to be added to existing electrical system.

By August Eckel

THE power problem in a midwest machine tool plant was becoming increasingly critical. New machines were needed to enable the plant to up its war production, but the existing electrical system just couldn't take the additional load—the spare capacity was non-existent. The first thought of the management, naturally, was the installation of a new transformer bank with circuits to handle the new equipment and help alleviate the overload condition of the existing bank. Contractor Wm. C. Schlosser, president, Capital Electric Co., Madison, Wis., had other ideas.

Capital Electric came into the picture when they were called in to investigate some trouble at the main switchboard. While diagnosing the trouble, Mr. Schlosser was informed of the new electrical system expansion plans. Being familiar with the habits of power factor gremlins, he requested —and was granted—permission to make an instrument survey of the plant electrical system. When he completed his survey and submitted his findings, the management discovered that the plant was operating at an overall power factor of .571, with some feeders as low as .35—a condition that was milking them of precious wiring capacity that was doing no useful work. Since the utility serving the plant had no power factor penalty clause in its power contract, the plant management was unaware of this unfortunate condition.

Contractor Schlosser was not satisfied with simply suggesting the installation of capacitor units to boost the power factor, but also recommended a modified rehabilitation of the service and feeders to reduce voltage drop and provide added flexibility. Recommendations included the substitution of a single entrance service breaker for an existing parallel switch arrangement; the discarding of an existing cumbersome and space consuming switchboard; and the installation of a flexible busway system to eliminate the existing long feeder runs.

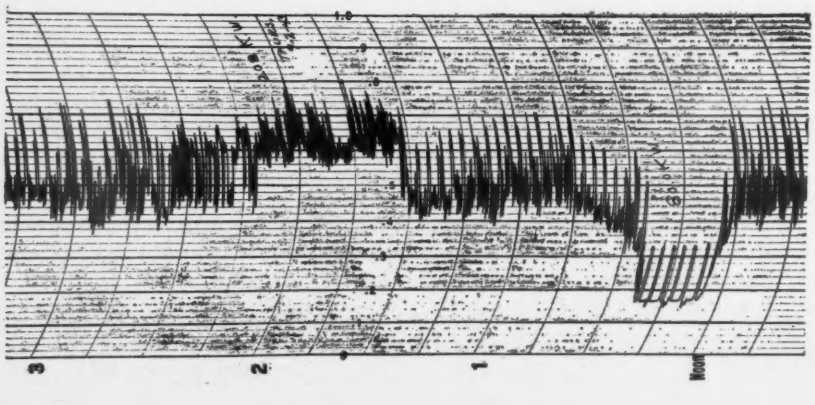


FIG. 1 — CHART PICTURE of the plant electrical load at the service as provided by the graphic wattmeter. Other chart sections taken included distribution panels.

Power Factor Bottlenecks

TABLE 1

SYSTEM ANALYSIS — POWER FACTOR

LOCATION	TYPE OF LOAD	DATE	TIME	AVG. LOAD KW. (chart)	AMPS.	VOLTS	KVA. (calc)	P. F. (calc)
Service		9-1-43	6:40 PM	147.2	780	220	297.0	.495
		9-2-43	8:50 AM	192.0	855	215	317.8	.607
			1:25 PM	192.0	880	210	320.0	.600
			1:35 PM	211.2	900	210	327.0	.645
		9-3-43	10:45 AM	160.0	790	215	294.0	.545
		9-4-43	8:30 AM	108.8	510	230	203.0	.535
Distribution								
Panel A	Milling	9-16-43	12:06 to 8:00 PM	9.6	55	210	20.0	.480
Panel B	Grinders	9-14-43	8:15 PM to 12:00 M	41.6	200	225	77.7	.535
Panel C	Turret Lathes	9-14-43	1:40 PM to 8:00 PM	22.4	120	225	46.8	.478
Panel D	Turret Lathes	9-16-43	8:10 PM to 12:00 M	16.0	120	220	45.7	.350
Panel E	Screw Machines and Lathes	9-15-43	12:00 M to 8:00 PM	48.0	240	225	93.7	.513
Panel B-1	Planer	9-15-43	8:10 PM to 12:00 M	25.6	150	220	57.0	.450

***TABLE 1—POWER FACTOR ANALYSIS** gives the complete story of the low power factor condition in the plant. Data includes the chart kilowatt readings and the ammeter and voltmeter readings used in computing the power factor values.*

***TABLE 2—CAPACITOR SIZES** required to raise the power factor to 90 percent are indicated as calculated. Recommended units are commercial size nearest to values computed.*

TABLE 2

RECOMMENDED SIZES OF CORRECTIVE CAPACITORS

LOCATION	CALCULATED SIZE	RECOMMENDED COMMERCIAL SIZE	TYPE OF LOAD
Panel A	13.76 Kva.	15.0 Kva.	Milling
Panel B	45.2 Kva.	45.0 Kva.	Grinders
Panel C	30.3 Kva.	30.0 Kva.	Turret Lathes
Panel D	34.0 Kva.	30.0 Kva.	Turret Lathes
Panel E	58.3 Kva.	60.0 Kva.	Screw Machines and Lathes
Panel B-1	38.55 Kva.	37.5 Kva.	Planer

The absence of a power factor penalty clause in the power contracts eliminated power bill savings as a salient argument for the change. The points that clinched and sold the job were:

1. Power factor correction would give the plant the sorely needed additional capacity in the existing system to permit the installation of new equipment without the need for new transformers and feeders.

2. The flexible busway feeder system would reduce voltage drop and increase the efficiency and flexibility of the power system—a feature highly desirable for present and future operations.

3. If power factor clauses are introduced into the power contracts at some future date, the plant will be free of the penalties.

For the survey, The Capital Electric Co. used instruments including

[Continued on page 144]

CAPACITOR CALCULATIONS

Example: Panel C

ORIGINAL SYSTEM

Meter Readings (Table 1)—KW. = 22.4 AMPS. = 120 VOLTS = 225

Calculated Values —

(1) $KVA = \frac{\sqrt{3} \times I \times E}{1{,}000} = \frac{1.732 \times 120 \times 225}{1{,}000} = 46.8$ (in table 1)

(2) $P.F. = \frac{KW.}{KVA.} = \frac{22.4}{46.8} = .478 = 47.8\%$ (in table 1)

(3) $rKVA.$ (reactive KVA.) $= \sqrt{KVA.^2 - KW.^2} = \sqrt{46.8^2 - 22.4^2} = \sqrt{1688.5} = 41.1$

CORRECTED SYSTEM

Desired Power Factor—90% KW = 22.4 (original load)

(4) Then $KVA. = \frac{KW.}{P.F.} = \frac{22.4}{.9} = 24.9$

(5) $rKVA. = \sqrt{KVA.^2 - KW.^2} = \sqrt{24.9^2 - 22.4^2} = \sqrt{118.25} = 10.88$

If:

Original rKVA. at 47.8% P.F. = 41.1 (calculated above)

Corrected rKVA. at 90% P.F. = 10.88 (calculated above)

THEN:

(6) Reduction in rKVA. by raising P.F. from 47.8% to 90% 41.1—10.88 = 30.22 rKVA.

(7) Commercial size capacitor recommended—30 KVA. (Slide Rule Calculations)

SIMPLIFIED METHOD — using Table of Factors on page 97, November 1940 issue of ELECTRICAL CONTRACTING. (Cornell-Dubilier Electric Co. chart).

For Panel C

Multiplying factor to raise Power Factor:

from 48% to 90%—1.343

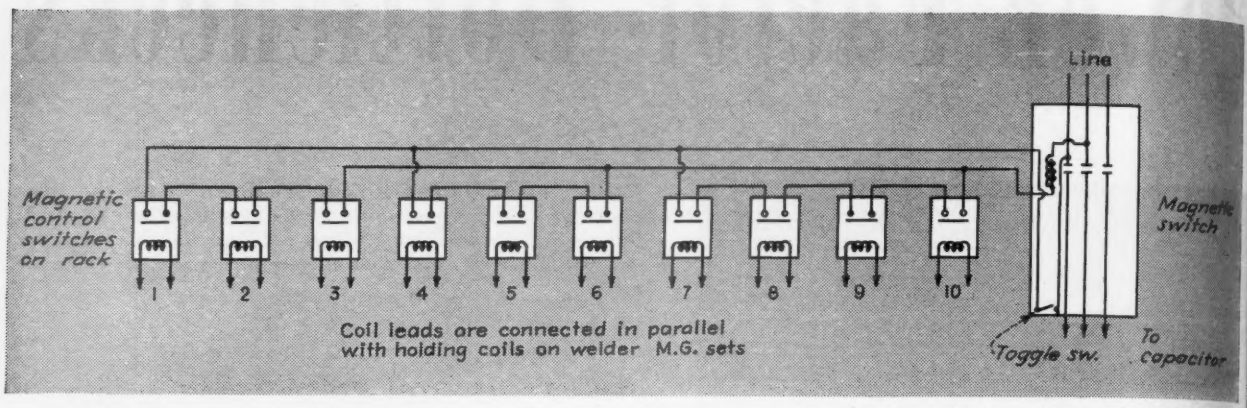
from 47% to 90%—1.397

from 47.8% to 90% (by interpolation)—1.354

KW. x 1.354 = 22.4 x 1.354 = 30.33 KVA.

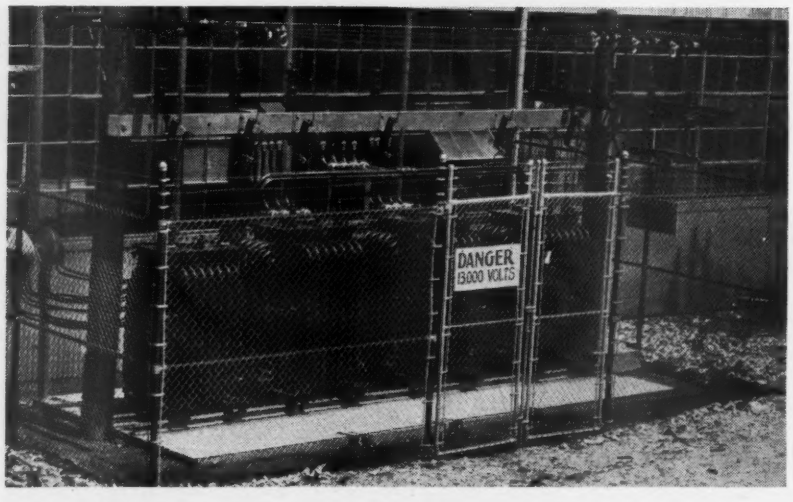
FIG. 2—CAPACITOR CALCULATIONS involved in arriving at recommendations outlined in Table 2 are indicated in this sample group of computations—using meters at Panel C

***SURGE PROTECTION** in case of a feeder outage is provided by this holding coil interlock between the capacitor and welders. Three or four welders must be in operation before capacitor is placed in the circuit. Magnetic control switches then operate, returning capacitor to line.*



ELECTRIC WELDING At Higgins...

Mezzanine mounted stationary welders sew up the seams of combat and cargo vessels at the Industrial Canal Plant of Higgins Industries, Inc., New Orleans.



***OUTDOOR SUBSTATION** serving welding and lighting load is typical of those spotted throughout the plant area. Stub poles support the 13,800-volt primary bus. IPS copper tubing constitutes secondary bus.*

THE crackling arc of the electric welder replaces the staccato tune of the riveting gun at the Higgins shipbuilding enterprises in New Orleans. Like numerous other yards turning out combat and cargo vessels on an assembly line basis, Higgins relies on electric welding to speed up production.

The installation and distribution of electric welding equipment varies with different yards. Some employ huge welding generators to supply d.c. buses with tap-off boxes along the ways; others use welding outlets with portable units that can be moved from place to place; still others install stationary units at various locations. The latter method is used extensively at the Higgins yards.

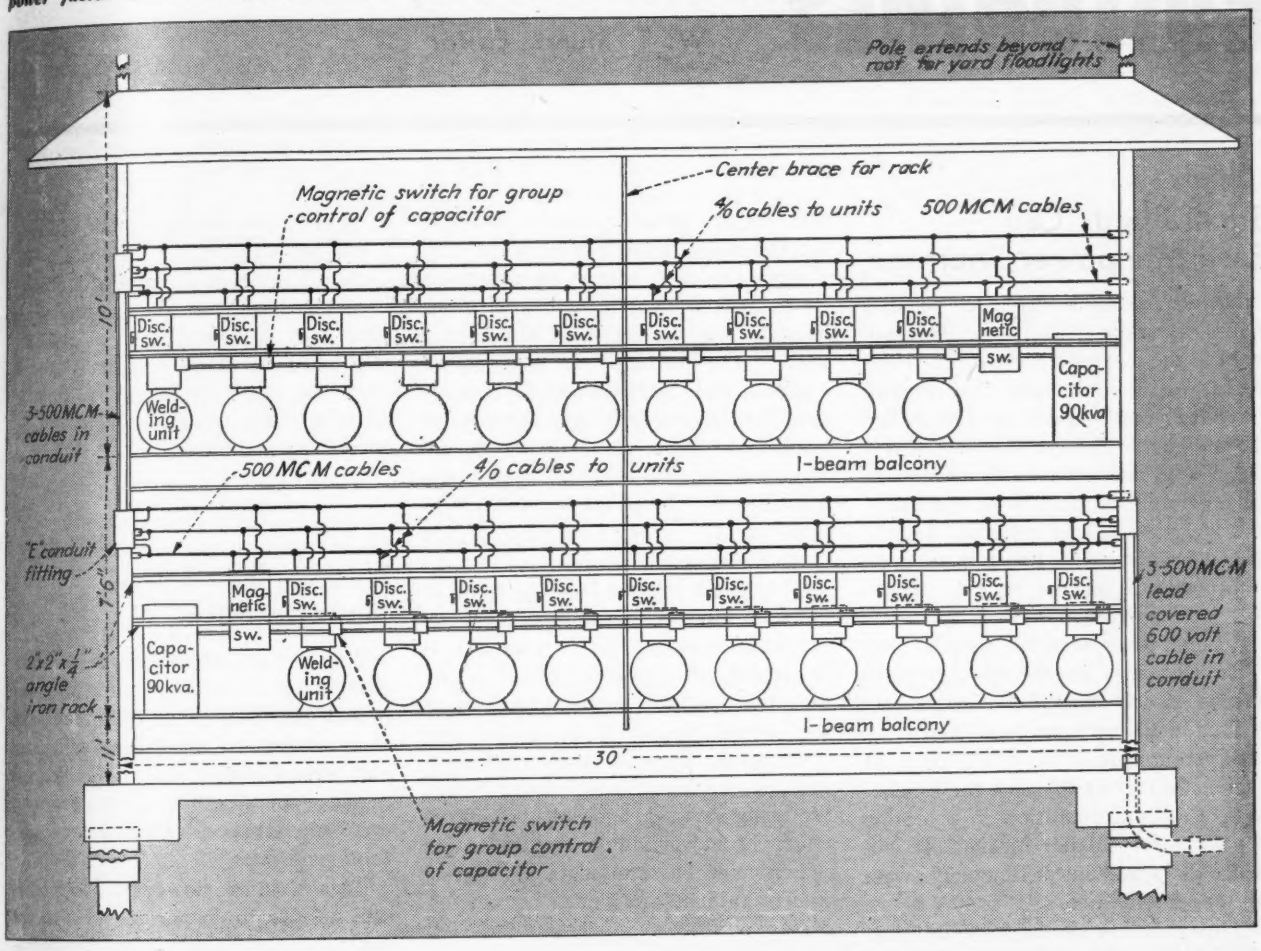
A general picture of the assembly line operation will foster a better appreciation and understanding of the welding system employed. Parallel lines of ships start at one end of a large building enclosure and, like the snowball rolling downhill, grow as they progress along the length of the building and emerge into the yard for final outfitting and floating. The keel of each small combat vessel is laid in a huge steel cradle which rides along on steel tracks embedded in the floor. As each section or portion of the ship is completed, this cradle is moved along to an advanced position where additional work is done.

A speedy assembly line operation of this type demands that welding units be available along the entire route. M. L. Levy, plant electrical engineer, accomplished this by installing banks of motor-generating welding sets along each side of the assembly line. He went one step further, however, and mounted the units on mezzanine platforms to provide free movement of materials on the ground areas.

Indoor Mezzanines

Inside the building the welding mezzanines are steel platforms with service catwalks bridging the building columns. A typical group of units consist of ten 300-amp. machines or 20-150-amp. units double-deck mounted to occupy the same space. Units are fed from a

***OUTDOOR RACKS** keep welding units grouped and out of the way. Open wiring bus feeds individual units with power factor correction provided by capacitors on each platform. Capacitor is electrically interlocked with groups of welders. Supporting poles are also used for mounting yard floodlighting units.*



3-phase, 440-volt, open wiring feeder running the length of the assembly line. Individual units are fed by conduit drops through fused disconnect switches.

Each welding unit is bonded to the steel platform, utilizing the building structural members as the return leg. The structure and steel rails, on which the ship cradles ride, are bonded to a ground bus at regular intervals to complete the return welding circuit. Each mezzanine welder group is equipped with a bank of capacitors (averaging 90 kva. for every 10—300 amp. units) to maintain the power factor of the feeders at an economical level.

The huge welding load in the plant is served by numerous 13,800/440-volt outdoor transformer substations spotted throughout the plant. A typical sub-station contains three 500-kva., oil-cooled, single-phase power transformers connected delta-delta and one 250-kva. single phase transformer for lighting load. The bare copper cable high tension buses are strung between crossarms, mounted on stub poles, and

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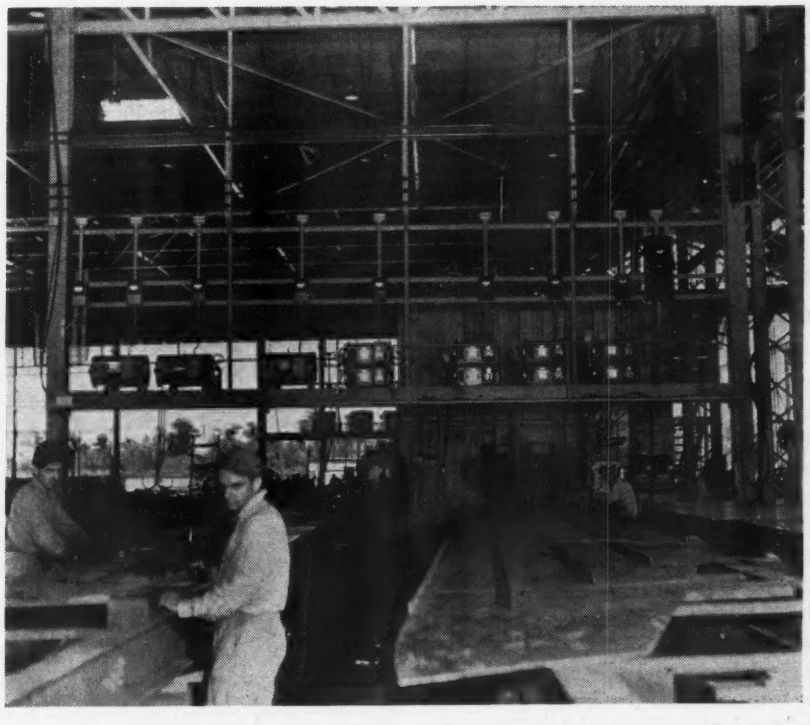


***INDOOR MEZZANINE** platform supports groups of stationary motor-generator welding units which parallel the assembly line. Capacitor bank on right boosts power factor of the feeder circuit.*

EDITORIALS

W. T. Stuart, *Editor*

Small Plants Can Ease Manpower Shortage

More subcontracting to smaller plants can make a substantial improvement in the manpower situation. First because it is axiomatic that overall manpower requirements are least when the work is brought to the place where the worker is. When the worker is taken from his normal surroundings to a new task he sets in motion a chain of new requirements, housing, services, transportation and so on that add to the net manpower problem.

Second, manpower can often be used more efficiently in the smaller plant due to closer supervision and direct contact with top management.

A recent request by WMC upon its regional directors to assist the Smaller War Plants Corporation in obtaining contracts for smaller business is evidence that government is acutely aware of the possibilities.

This program should have full support from our industry. It will strengthen business in some less acute labor areas and open the way to sorely needed electrical modernization of some of the smaller plants in our own communities, a net gain in total facilities at comparatively small cost of critical materials.

Annual Wage Needs Study

The NECA-IBEW postwar plan proposing that an annual wage should be considered by the electrical construction industry is a challenge to the best minds that can be put to work on the problem. The study will take a high order of good will, sincerity, wisdom and plain common sense. The facts must be clear.

In effect, many contractors have paid their key men on essentially that basis for years by moving them from job to job so that they get in full time regularly. Such men could probably be swung over to an annual wage agreement with little disturbance to the routine operation of the business. On the other hand, however, the employer could not assume an obligation for an annual wage for every wireman he will need on his work during the year. The fortunes of competitive business and the fluctuations of construction labor needs defy the precise predictions that would have to be made before practical business judgment would allow the contractor to take on more than a portion of his crew on an annual basis.

The whole job need not be done in one leap anyway. If it proves practical it could come along in evolutionary stages. And probably as fair a way to gather accurate experience data as any would be to set up, within the framework of local agreements in a few key cities, an optional annual wage, requiring mutual agreement between employer and individual employees and which could be restored to the normal hourly rate at any time.

Ground for Appliances

The problem of grounding household appliances is again actively before the industry. Code committees have it under consideration and there is reason to hope that a generally acceptable policy and method may soon be proposed.

Forthright action is long overdue on this important phase of grounding. The appliance or lamp on the end of a cord has pretty much neutralized our efforts to make wiring safe. A permanently installed motor, rarely touched, is carefully grounded. A portable mixer or fan, frequently handled may become dangerously alive with a minor insulation breakdown. A lamp receptacle, installed in the ceiling must have the shell grounded. A floor lamp with socket shell readily accessible has a 50-50 chance of a live shell and only the protection of the insulation against becoming wholly alive.

The cost of three conductor cords as against two conductor can add only a few cents to the cost of portable devices. The economic cost of a change in receptacles to take a grounding plug may be considerable. But the step must be taken eventually and a start ought to be made as soon as practical and workable methods can be agreed upon.

Electronics—A New Department

The precise pattern that industrial electronics will follow after the war is unpredictable. There is no long and clear pattern of experience which we can extend into the future because much of the development has appeared under the stress of extraordinary wartime conditions.

This we know, however. Electronics will assume an important role in the control of processes and in the operation of electric circuits in industry and will find wide and common application in commerce and the home well outside of the inevitable gadget field.

Electrical contractors and electrical men in industry upon whom will fall the responsibility for selecting, applying, installing and maintaining electronic apparatus will contribute little to fundamental design of electronic circuits. Yet, because they are the folks who will have to live with it, they must have some knowledge of design considerations and a ready understanding of what electronic apparatus can do and cannot do.

During recent months, we have published a series of articles on the fundamentals of electron tubes. These are not especially easy reading. The phenomena of electronics is not simple. But those who take the trouble to study and ponder the technology of electronic tubes are finding a fascinating new understanding, not only of electronics, but of all electrical phenomena.

There is no short cut to the rounded knowledge essential to intelligent use and application of electronic apparatus. The fundamentals must become as

much a part of our thinking as the fundamentals of wiring or motor application.

In this issue we begin a new department devoted to electronics as it will affect our field of activity. We hope that the material will accurately meet your needs and we want your frequent comments on it. Your questions, too, will be welcome and answered by competent authorities. How elementary or how advanced we make this department is up to you. Let us have your suggestions.

Restrictions To Continue

Continued restrictions on construction and facilities are announced by War Production Board chairman, Donald M. Nelson. "There must be no modification" he says, "of the restrictions until we are certain, from the course of the war, that such modification would not harm the War Production Program." And there can be no argument with that position. No one would have it otherwise.

However, there is a responsibility inherent in the restriction on construction to avoid cramping war production by too rigid application of the rules. Broadening the scope of permissable maintenance and repair work would help. It is also imperative to keep a well organized and competently staffed construction industry on tap for any eventuality. This is particularly true of a specialized organization like the electrical contractor. And this can be helped by opening the way to more contract work on ships and plane construction to building contractors. A healthy industry can leap into full action for war work or postwar job creating activity overnight. And a healthy construction industry is essential to war and peace.

Organization Will Tell

Newberry Electric Corporation of Los Angeles, celebrating its fortieth anniversary, has sent out an impressive brochure to its customers. With extraordinary editorial restraint it pictures its large staff of executives, superintendents, engineers, and estimators. It lists important jobs, pictures a few and winds up with its organization chart. The tremendous scope of activities which have added so much to the life of the West and the huge roster of seasoned engineers and specialists are summarized most aptly in the lines and squares of the diagram showing the relationship of each to the organization.

In a recent study by the Russell Sage Foundation, "Technology and Livelihood" is this significant comment—"the new science has given man access to (1) electric power, (2) chemical action, (3) mechanical movement; these three can be used for production only if a fourth element, *organization,* be provided."

And an organization, such as Newberry Electric, is the integrating force which brings seasoned skills and expert minds to bear on physical problems. As the scope of activity widens and technological changes make problems more complex, the need for linking specialists together to meet them becomes more urgent.

In the years ahead, electrical contractors will be facing great opportunities in market development. Lines of organization we already have within individual firms and out through the industry will largely determine whether or not we made the most of them.

Reduce Job Accidents

Joe Keenan, vice chairman in charge of labor production for WPB is setting out on an intensive campaign to reduce industrial accidents. "Every year", he says, "about a full division of soldiers of production die of accidents at their work—and to a nation at war, the loss of 18,000 workers is a heavy blow".

Federal agencies, labor and management will be asked to help solve specific industry problems. Labor will be asked to accept wider responsibility in the health and safety field. Special labor-management committees will be urged. The Labor Department and Office of Education will be asked to assist in spreading educational literature. The anti-accident campaign as a whole will be carried out by the Industrial Health and Safety Section of the Labor Production Office.

Electrical work accident experience is nothing to feel complacent about. Our compensation rates are high. A comprehensive, industry wide campaign to cut accidents now can help in the big jobs across the oceans. And it ought to be a permanent institution.

Washington Notes

▶ Imminent invasion and its effect in bringing the European phase of the war to a quick conclusion is the underlying theme behind all Washington activity. What about relaxing this or that regulation? When can we get into reconversion in a big way? One high official remarked that it's better to be two or three months late in an important element of reconversion than five minutes late with anything our forces will need when they land on the beaches of the continent.

▶ The President's proposal for a National Service Act is finding rough going. Certain labor leaders claim privately that they have backed the Act's proponents into a corner where their only justification turns out to be "helping soldier morale". As for the strikes, they refer to Britain's experience. National Service hasn't stopped strikes there. Meanwhile official statements indicate the overall manpower situation is improving. Serious shortages exist in some communities, but headway is being made and turnover decreasing.

▶ Army and Navy heads still vigorously oppose any construction not directly connected with immediate essential war needs. WPB officials are urging some badly needed essential civilian construction where materials, manpower and equipment are available.

▶ Materials are easier in practically all categories. Improvement in the copper situation will contribute to better munitions, however, before it will be widely noticeable at the general industrial level. Secondary aluminum is especially plentiful, and most criticals can now be used wherever labor saving will result.

▶ Maury Maverick, new head of the Smaller War Plants Corp., is proving a strong champion of small business and free enterprise. He wants small business used to capacity on war subcontracting and helped into essential civilian production as cutbacks trim contracts.

▶ Social Security has recommended a comprehensive national social insurance system, expanded to include, besides unemployment and old age, sickness, disability and partial hospital and medical care. The proposed plan would take six percent of payroll.

BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

PRACTICAL METHODS

HIGH CYCLE GRINDERS

INDUSTRIAL

Twenty-nine high-cycle grinders, spinning at 10,000 r.p.m., are in constant 24-hour production line service at a Carnegie-Illinois Steel plant. This is of course pretty severe service for any type of variable load equipment. The grinders are rated 3000 watts, 220 volts, 3 phase at a rotor speed of 10,000 r.p.m.

After the grinders were first put into service, outages occurred within 24 hours while some lasted as long as three weeks. In every case, phase to phase short circuits were found to be the cause, since the phases were uninsulated from each other except for the baked enamel coating on the wire.

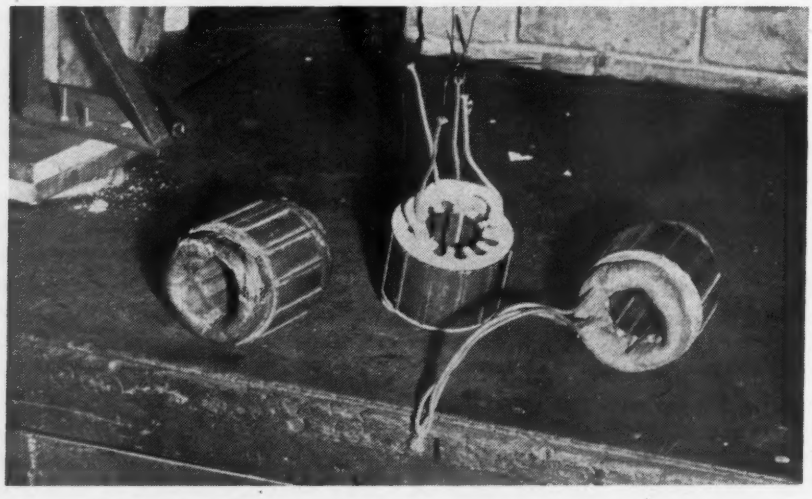
All the grinders were rewound in the plant's motor repair shop and a thin insertion of insulation was placed between phases. This proved to be a very tricky proposition, since the stators were quite small, with no room for phase insulation allotted in the original design.

During the six months which have elapsed, only one failure has occurred in all twenty-nine grinders, and indications are that they will last for a long time to come despite the severe duty to which they are subjected.

CODING FOR QUICK CIRCUIT IDENTIFICATION

INDUSTRIAL

In a continuous process where each operation depends upon the preceding one, quick restoration of one failing link is extremely important. In the manufacture of cigarettes, the process from one end to the other, is one conveyorized, integrated system. Each single conveyor for horizontal material handling is driven by one or more small motors (in the range of 2 to 5 hp.) The tobacco leaf is carried vertically by suction or blower fans. It is carried for miles over inspection conveyors and from floor to floor, while workers sift out stems, foreign matter and off-color tobacco. Extreme precaution is taken to assure that only the finest leaf arrives for final flavoring and blending.



HIGH CYCLE GRINDER stators that failed in the absence of phase to phase insulation. On the left is one that has failed, showing the original insulation. In the center is a stator partially rewound showing the phase insulation that has been skillfully applied to prevent further failures. On the right is one completely rewound and does not appear to be much bulkier than the original job despite the added insulation.

LARGE NUMBERS, which can be easily and quickly identified in the event of emergency, are painted in a conspicuous place on the machine rather than on the motor. In this way the numbers can be made larger and if the motor should be replaced, the number remains to identify this machine's drive with the proper disconnect and starter at the board.

It is easily seen that in such a long integrated system as this, quick restoration in case of failure of one element is essential. In addition, a strict preventive maintenance program is increasingly important if failures are to be reduced to an absolute minimum.

At Phillip Morris Company's Richmond plant, R. E. Powell, chief electrician, has made provision for quick restoration by coding all circuits at each end. Coding is accomplished by a simple system of numbering. Further the circuits of each integrated group of drives emanate from one control center. Thus, if the tobacco starts piling up from the failure of one particular motor, the operator need not frantically search the walls and ceilings for conduits and switches. He takes the number (painted in large white letters in a conspicuous place on the machine or conveyor) and proceeds to the control center which is usually never very far away even from the

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- That free competition is the life of trade – and progress;
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- That there will always be room at the top for independents working together to supply better things for more people.

The test of war is being met, and important contributions are being made by independents in our field — both wholesalers and manufacturers. The opportunities of peace shall be realized and greater service rendered by these same independents. When the range of Sylvania products and operations is expanded, we will look first to independent wholesalers to sell new and improved products to the home, to commerce and to industry.

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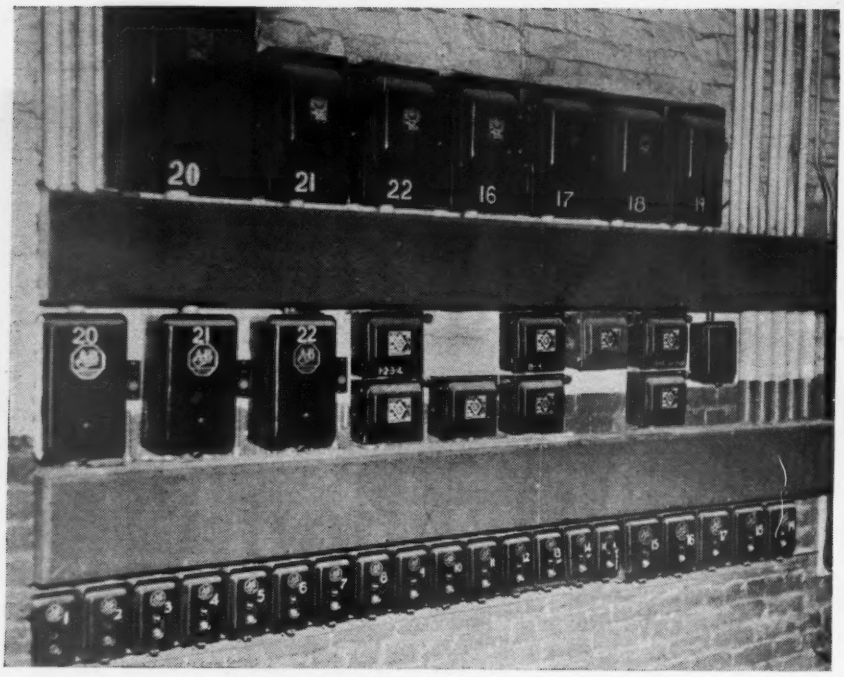


DISCONNECTS AND STARTERS are painted corresponding numbers to speed circuit tracing in emergencies. All control for one integrated system of drive is located at this point so that a failure of one element of the system cannot cause pile-up from a preceding drive's continued feed. Operator can stop pile-up from this point. Roomy auxiliary gutters adds not only to the appearance, but also facilitates installation and maintenance.

furtherest machine. If the starter will not reset immediately to put the drive back into operation, he can then shut down all the drives clear back to the beginning, from this one point of operation. Definite advantage is seen over a mounting of control at each machine or drive point. In the meantime, electricians stationed in each area are quickly summoned. Drive units or control are replaced if a speedy repair job cannot be made on the spot.

OUTDOOR MOTOR HOUSE

INDUSTRIAL

When the Oak Ordnance Plant was built in Illinois, it was a rush job—speed had to be maintained to get the plant in operation in the shortest possible time to start ammunition rolling off the lines. Materials were hard to secure and special equipment such as explosion-proof motors were at a premium. So the plant was designed to make use of as much conventional standard equipment as was practicable.

If a standard motor could be placed outside a hazardous area to perform the same function as an explosion-proof unit indoors, it was done. This was the solution to the drive for a machine used to drill T. N. T. out of the head of shells to make room for the booster. However, some type of weather protection had to be provided for the unit.

The machine, located inside the building, is driven by a line shaft extending through the building wall and coupled to a 5 hp., 1800/155 rpm., 208-volt, three-phase, gear head motor mounted on an elevated wood platform at line-shaft level. To protect the standard type motor from the elements, a wood house was built over the platform. One end of the enclosure consists of wood louvers for ventilation. The bottom of the platform is open framework providing good air circulation. The front consists of two hinged doors which open wide for inspection and maintenance purposes.

Explosion-proof control for the motor is on the inside of the building. Control circuit conductors are carefully sealed where they enter the building.

INFRA-RED USED FOR SALVAGE

INDUSTRIAL

Because of the critical steel situation, The Norton Company of Worcester, Mass., manufacturers of abrasive materials and grinding machines, have resorted to salvaging the steel plates on which the abrasive grinding wheels are mounted. When the wheels have become worn beyond usefulness, the customer ships back the mounting plates for reprocessing. In the past they were scrapped because of handling charges and due to the fact that in reprocessing, if the plate becomes warped, it is extremely difficult to true up. The plate must be perfectly true and balanced before an abrasive wheel can be mounted onto it in view of the high speeds at which the wheels operate.

Rubber cement is used for adhesion and has a critical temperature of about 400° F. When brought to this temperature, an operator merely scrapes the old wheel from the plate and wipes it clean.

At first gas hot plates were used and then electric ovens, but both were unsatisfactory from a warping and production standpoint. Now, an infra-red oven is used and has proven very satisfactory. Due to the even distribution of heat intensity, warping has been practically eliminated. Handling time has been reduced to a fraction of that required by the two previous methods.

The oven itself is mounted in an angle iron frame. The two vertical banks of lamps which face each other are spaced about six inches apart and are adjustable. The wheels are hung from hooks on a double sliding panel, that operates like the slide holder of a slide lantern projector. In this manner, a group of 16 wheels can be bak-

SECURELY HOUSED in an outdoor wood enclosure, this gear head motor operates a T.N.T. drilling machine inside this ordnance plant shell loading line.

Free Enterprise

. . . INCENTIVES AND TAXATION

There are three principal ways of making a living:

1. Getting on someone's payroll
2. Lending one's savings to business enterprises
3. Starting, or helping to start, a business enterprise

About three out of four of us fall in the first group—we are ***job-holders.*** Millions of us get some income, large or small, by lending our savings—directly or through such channels as insurance companies. We are suppliers of ***loan-capital.*** About one out of four of us has his own business enterprise, and several millions of us are part owners of business enterprises. Those of us who go into business for ourselves and those of us who are part owners of enterprises are ***job-givers.***

The amount of employment in a community depends, in the main, on the number of persons who attempt to make their living, or part of their living, by giving jobs to others, rather than by getting on someone's payroll. A community seriously desiring a high level of employment and a high standard of living will strive to make job-giving attractive and to encourage a large part of its population to be job-givers rather than merely job-holders.

The number of men who attempt to make their living in whole or in part by starting new businesses or by expanding old ones depends upon the outlook for profits. When the outlook for profits improves, thousands of new jobs open up and thousands of men go to work; and, as men go to work, the farmer and everybody else benefits. When the prospect for profits becomes darker, the demand for labor, capital, and raw materials drops. It may be roughly estimated that an improvement in the prospect for profits of one billion dollars raises the demand for labor by anywhere from two billion dollars to five billion dollars.

One of the principal determinants of the outlook for profits is the amount and the nature of taxes. After the war, the Federal government will need to raise each year about twenty billion dollars in taxes—three times the amount required before the war, and six times the amount re-

quired in the Twenties. In the Twenties, the tax needs of the Federal government were roughly twice as large as corporate profits in a good year. After the war, Federal revenue needs will be roughly three times corporate profits in a good year. Obviously, it will be much more difficult, after the war, for the government to meet its needs *without discouraging enterprise,* and therefore without diminishing the number of jobs, than it was before the war. Far more than ever before, it will be necessary for the government in developing a tax program to take account of the effect of taxes upon employment and the standard of living. This means that it will be important for each and every citizen to give attention to these matters—because the policies of the government reflect, in the main, the thinking of the citizens.

Some taxes seriously discourage individuals and business firms from undertaking new and enlarged operations. Other taxes have little or no adverse effect on investments. Some taxes are a burden on consumption, affecting the sales of specific commodities, depending on the nature of the taxes. It is obvious that different kinds of taxes have different economic influences. *We must understand the forces that determine the level of employment and consider the tax program in relation to other measures designed to create more jobs.*

What are the tests of a good tax system?

1. **Taxes should be designed to encourage production and enterprise and to make it attractive for a large number of people to earn all or part of their living by giving jobs to others.**

2. **Taxation must be fair in principle and administration, with no discrimination between persons in similar circumstances.**

3. **Taxes should be apparent and not concealed, and should be levied, in the main, directly upon individuals so that each of us will know how much our government is costing him. A moderate income tax at the lower income levels will bring a greater awareness of responsibility than will heavy taxes on consumption which the taxpayer does not see because they are hidden in the prices he pays.**

4. **In the aggregate, taxes should be somewhat progressive.**

5. **The tax system should be coordinated with the broader objectives of monetary and fiscal policy.**

6. **Federal, state, and local tax policies should be integrated as to principles and objectives.**

Judged by these standards, our present tax system is extremely unsatisfactory; in fact, it is actually damaging. It is a conglomeration of hidden and direct taxes and of conflicting taxing jurisdictions and policies, with no comprehensive economic motive. It is distorted to appease pressure groups and includes uneconomic punitive measures. It is full of needless complexities. It is a paradise for tax lawyers and a source of confusion and despair for the honest, enterprising business man. In fact, it would seem almost as if our tax laws had been written by some fifth columnist for the purpose of making private enterprise unworkable. We in America pretend to believe in the pioneer spirit, but no one would ever suspect it by looking at our tax system.

When the war is over, there must be a thorough reform of our entire tax system. Federal taxes can and should be reduced substantially; and, in the process of reduction, changes can more readily be introduced. At that time, steps can be taken to achieve some degree of coordination and unity of purpose among federal, state, and local taxing agencies. Taxes play too important a role in our total economic life to ignore the adverse consequences of unrelated and inconsistent policies of different taxing jurisdictions.

The following reform measures are needed in federal taxation:

1. **Repeal of the excess profits tax at the earliest possible date after inflationary dangers subside. In the case of most enterprises, the excess profits tax destroys all incentive to do a larger volume of business than in 1939; it appropriates virtually all increase in profits above the level of 1939.**

2. **Coordinate corporation and individual income taxes so as to avoid double taxation and impediments to risk-taking. Preferably, corporation income taxes should be wholly eliminated. Otherwise, the corporation tax rates should be reduced to the lowest effective rate on personal incomes. Full credit should be given to stockholders for all corporate income taxes paid.**

3. **Encourage competition and particularly the formation of new enterprises by allowing new corporations generous tax exemptions for a period of five years. Extend the same principle to unincorporated concerns.**

4. **Encourage risk-taking (and hence job-**

giving) through extending the loss carry-over to six years or more.

5. Provide for averaging incomes over a period of years in order to remove discrimination against those with irregular incomes and those who take risks of loss in business ventures.

6. Rely upon the personal income tax as the main source of revenue, with broad coverage. The reduction in total taxes after the war should favor the elimination of excise taxes before reducing income taxes.

7. Reduce the upper range of personal income tax rates to a maximum of perhaps fifty to sixty per cent so that risk-taking investments will be really attractive. Higher rates are punitive in character, yield small receipts, and throttle risk-taking.

8. Encourage risk-taking by individuals in the higher brackets by making the surtax on incomes of $20,000 a year or more half as much on income in the form of dividends as on income in the form of salaries or interest.

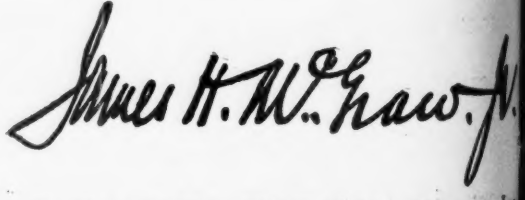
9. Encourage risk-taking by individuals by permitting capital losses to be charged against general income provided the reduction of tax liability in any one year is not more than fifty per cent.

10. Repeal the tax-exempt privilege for all *new* securities issued by all governmental jurisdictions.

11. Eliminate excise taxes which place a disproportionate burden on persons with lower incomes so as to encourage greater consumption and provide an expanded market for our vast industrial capacity.

12. Reform tax administration to simplify forms and procedures, to broaden the scope of enforcement, and to encourage the spirit of fairness.

With such reforms and continuing reappraisal of the tax program as it affects the economic situation, we can look toward taxation as an instrument of constructive influence in giving the fullest encouragement to free enterprise and in attaining continued prosperity.



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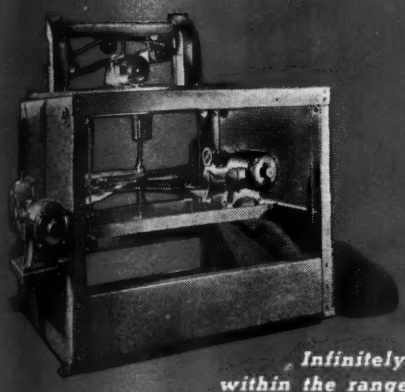
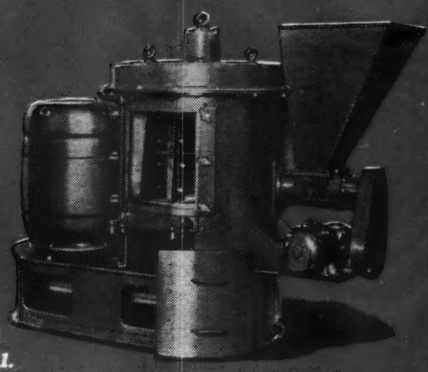
BUY UNITED STATES WAR BONDS AND STAMPS





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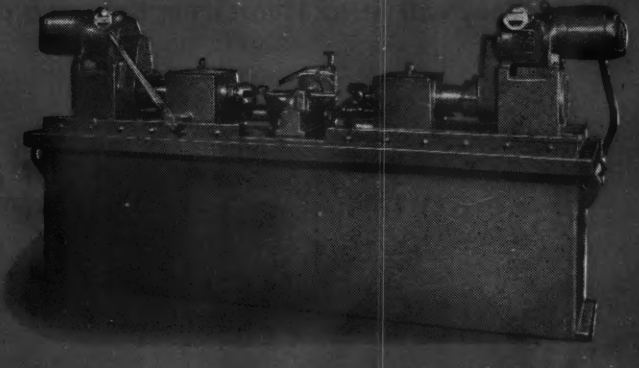

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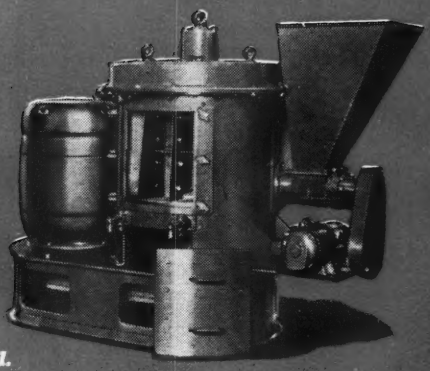

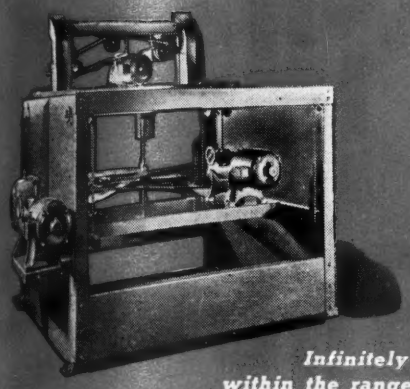

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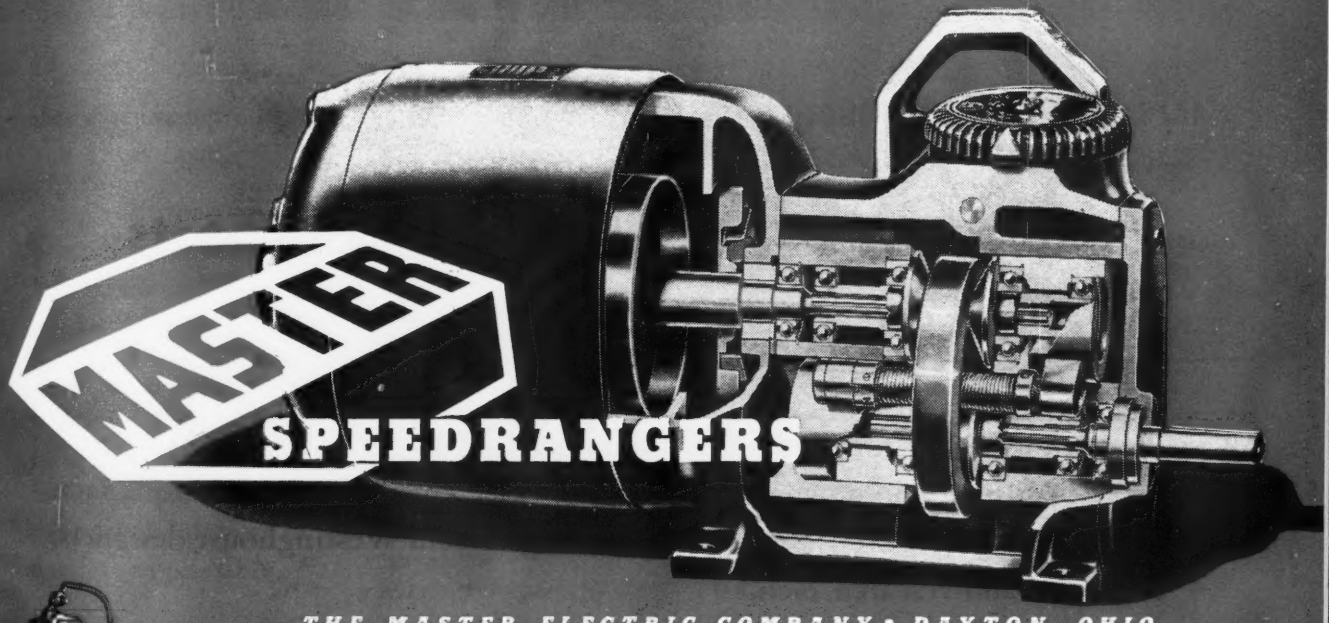

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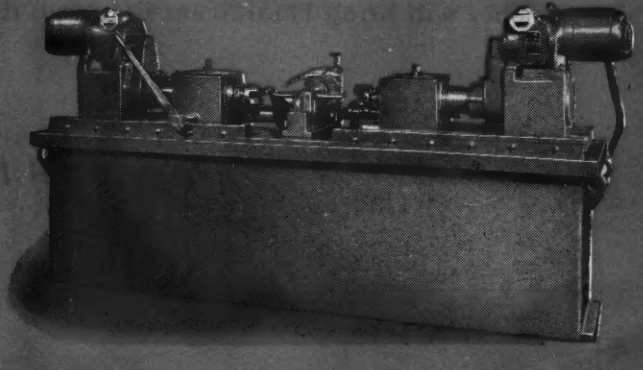
Available in the vast number of types that make up the Master line including the flanged type as shown, also gearhead, unibrake, fan-cooled, explosion-proof, splash-proof, multi-speed, etc.

Save material and save space with the simple compact, integrally built Master Speedranger. The all-metal construction insures greatest possible durability and freedom from service interruptions.



Westinghouse reports to the Lighting Industry . . .

Predictions about tomorrow are plentiful. But in order to plan, you need more than predictions, you want the facts. Here, then, are the simple facts about tomorrow's Fluorescent Lamps, straight from Westinghouse designers, engineers and research men.

YOU WILL HAVE CIRCULAR FLUORESCENT LAMPS

Dimensions have been worked out, as indicated on the opposite page.

YOU WILL HAVE LONG, THIN FLUORESCENT LAMPS IN NEW SHAPES AND SIZES

Dimensions have been worked out, as indicated on the opposite page.

These new Fluorescent developments, pressed forward by Westinghouse research, will provide the Lighting Industry with a remarkable opportunity for expansion. They will bring Fluorescent light into the home—in portable lamps and new fixtures

☆ FOR LEADERSHIP IN LIGHTING . . .

ABOUT TOMORROW'S FLUORESCENT LAMPS

that meet accepted standards of decoration and good taste.

They will open up new merchandising opportunities for stores, theaters, restaurants, hotels, office buildings, transportation terminals and other commercial enterprises.

We cannot tell you when these new lamps will be available, for Westinghouse manufacturing facilities are still heavily engaged in war work. But we will advise you as to their availability as far in advance of production as possible.

One more fact about tomorrow's Fluorescent Lamps. You can be sure that the Westinghouse name on a lamp will continue as a pledge of quality and dependability—assured by persistent Westinghouse research and engineering know-how.

Westinghouse Elec. & Mfg. Co., Bloomfield, N. J. Plants in 25 cities . . . offices everywhere.

WESTINGHOUSE MAZDA CIRCULAR FLUORESCENT LAMPS *Sizes to be produced and current consumption*

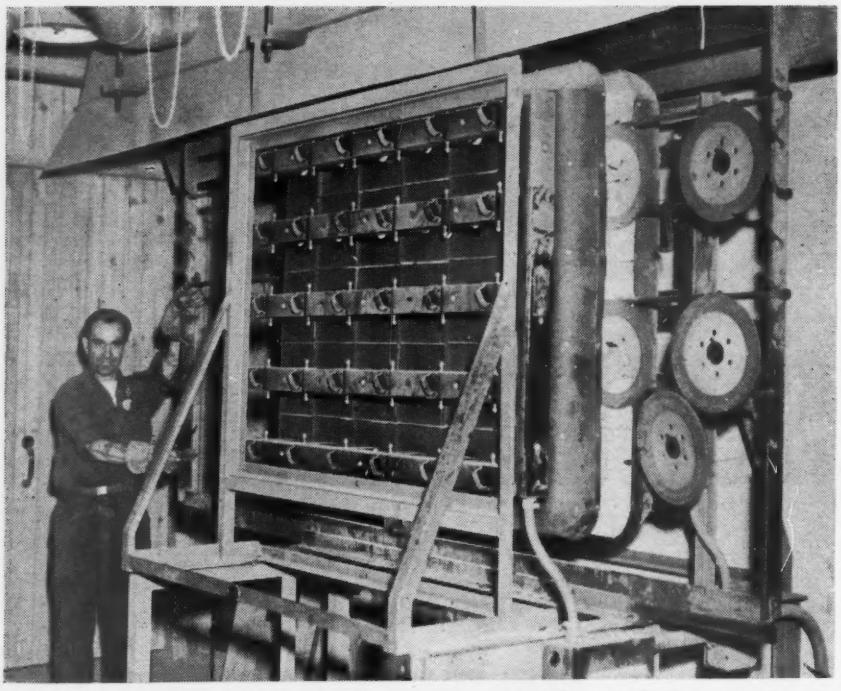
Approx. Overall Outside Diam. of Circle	Maximum Tube Size	Approx. Watts
8½ in.	1¼ in.	20
12¼ in.	1¼ in.	30
16 in.	1¼—1½ in.	40

WESTINGHOUSE MAZDA LONG THIN FLUORESCENT LAMPS *Sizes to be produced*

Length Including Sockets	Approx. Tube Diameter
5½ ft.	½ in.
5½ ft.	¾ in.
5½ ft.	1 in.
7½—8 ft.	¾ in.

. . WATCH **Westinghouse**

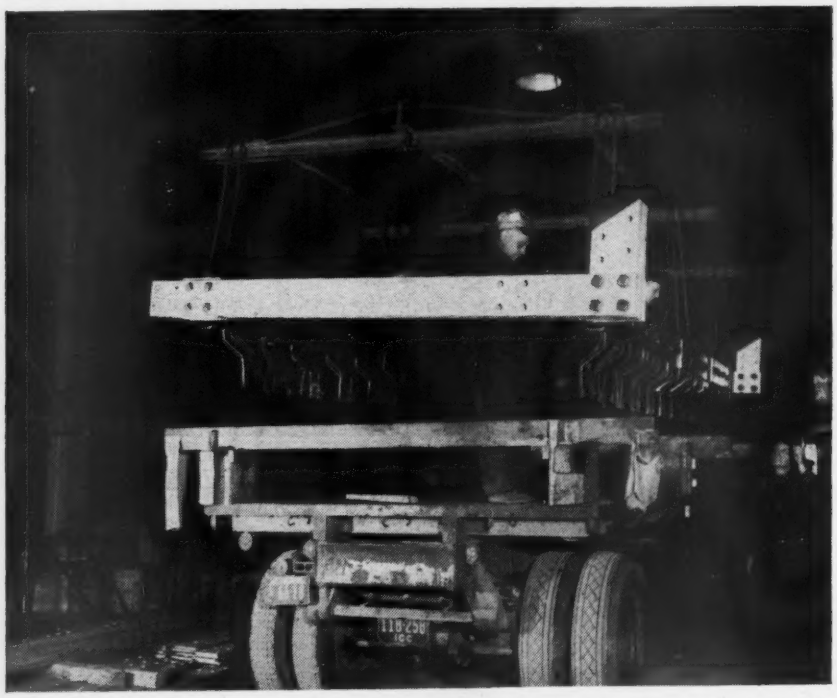
MAZDA LAMPS FOR SEE-ABILITY



INFRA-RED OVEN used for obtaining an even, critical heat to eliminate warping of steel plates. A high reflection efficiency is obtained by using individual gold leaf reflectors. Double sliding panel allows a group of wheels to bake while a previously baked group is being handled.

ing in the oven while the operator scraps the 16 wheels previously baked and reloads. By this time, the next 16 are ready for scrapping and so on.

Thirty 500 watt lamps are used in each bank for a total of 60 lamps giving the oven a 30 kw. rating. The lamps are spaced on six inch centers; each lamp is individually adjustable and backed by a 6-inch by 6-inch gold leaf reflector for greater reflection efficiency. In fact the reflection efficiency is so good that the back of the reflector plate is cool to the touch of the hand. The oven is a custom built unit by Fostoria. Feeders are 440 volts and four lamps are connected in series, each rated 110 volts. The balanced three phase load is controlled from a single three pole switch.



TRUCKS are used to carry the silver ring buses to the aluminum pot from the assembly table. The straps hanging down are made of copper and are connected to the steel collector rods which are buried in the bed under the alumina bath. The operation is in connection with the construction of an aluminum plant.

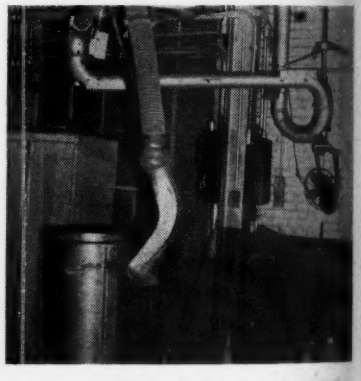
REMOVING WELDING FUMES

INDUSTRIAL

Annoying fumes generated by electric welding arcs can become quite hazardous to personnel working in the confines of a welding booth. Unless some exhaust method is employed, the welder may inhale flux from the welding rod and experience the resultant detrimental effects.

Ray Stroppel, maintenance engineer for the Tool Steel Gear and Pinion Company in Cincinnati, Ohio, realized the importance of keeping the atmosphere in welding areas clean from the standpoint of employee health and plant maintenance. To solve this problem he installed an exhaust duct system which serves a row of three booths, each enclosed by fireproof canvas curtains.

Each welding booth is equipped with a metal collector nozzle attached by a metal ball and socket joint to a flexible hose. This hose is connected to a round metal duct arm which swings, by means of a flexible elbow



FLUX FUMES from electric welding arc are drawn into this collector nozzle of the welding booth exhaust system, keeping work area and booth atmosphere clean.

connection, through an arc of approximately 180 degrees in the horizontal plane. Vertical adjustment of the collector nozzle is provided by a counter-weighted arm attached to it. This permits the operator to move the nozzle up or down depending on the height of the object being welded. When in use, the nozzle is set far enough ahead to cover the amount of welding done by one rod. Then it is moved ahead again for the second rod.

The duct connections to the individual booths terminate in a master duct line which leads to the open air outside the building or to a dust arrester, whichever the case may be. The exhaust air current in this three-booth installation is maintained by a fan driven by a 2 hp. motor. In

[Continued on Page 136]

the rubber shortage doesn't affect this wire

HAZAKROME

SMALL DIAMETER BUILDING WIRE

AVAILABLE FOR WAR-PURPOSE — MAINTENANCE • REWIRING • NEW INSTALLATIONS

HAZAKROME is an approved synthetic insulation containing no rubber. Possessing practically all the desirable qualities of the finest rubber insulation, HAZAKROME also offers many features that rubber lacks — particularly non-inflammability and resistance to oil, moisture, ozone and atmospheric conditions.

Consisting only of copper and a thin layer of insulation, HAZAKROME wires are easier to handle, splice and connect than Type R wire. HAZAKROME is particularly useful for rewiring jobs, where its small diameter increases the capacity of existing conduit by as much as 2 and 3 times — thus eliminating the expense of conduit changes, plastering and redecorating.

With the use of natural rubber forbidden in the manufacture of wire for most commercial applications, HAZAKROME has become a timely and welcome alternate. Its use is permitted in applications where copper is allocated.

HAZAKROME wires fully meet the rigid safety requirements of the 1940 National Electrical Code. Write today for your copy of Bulletin 200 — THE HAZAKROME HANDBOOK.

HAZAKROME FEATURES—

- A complete range of sizes for both lighting and power-circuits.
- Resistant to moisture, oil, chemicals and flame.
- Smooth, glossy and lubricated surface — easy pulling.
- Available in non-fading, standard building wire colors.
- Chemically stable and long aging.
- Tough insulation — a tensile strength of 2000 lbs. per sq. in.
- Free stripping — easy to install.
- No outer covering required.
- Small diameter — permits greater conduit fill.

CONSIDER HAZAKROME FOR BUS-DROP CABLES TOO

Developed to meet the widespread use of bus-duct systems in factories, HAZAKROME Bus-Drop Cable will bring power to individual machines — *quickly* and at *low cost*. No conduit and no pulling is required. Ordinary squeeze-type armored cable fittings and porcelain hangers can be used. » » HAZAKROME Bus-Drop Cable consists of 3 stranded conductors, insulated with color-coded HAZAKROME, and three small stranded ground wires equivalent in cross-section to one power conductor. These are cabled with necessary jute filler, covered with tape and a final HAZAKROME jacket.

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ARMY E NAVY

3422

HAZARD Electrical Wires and Cables

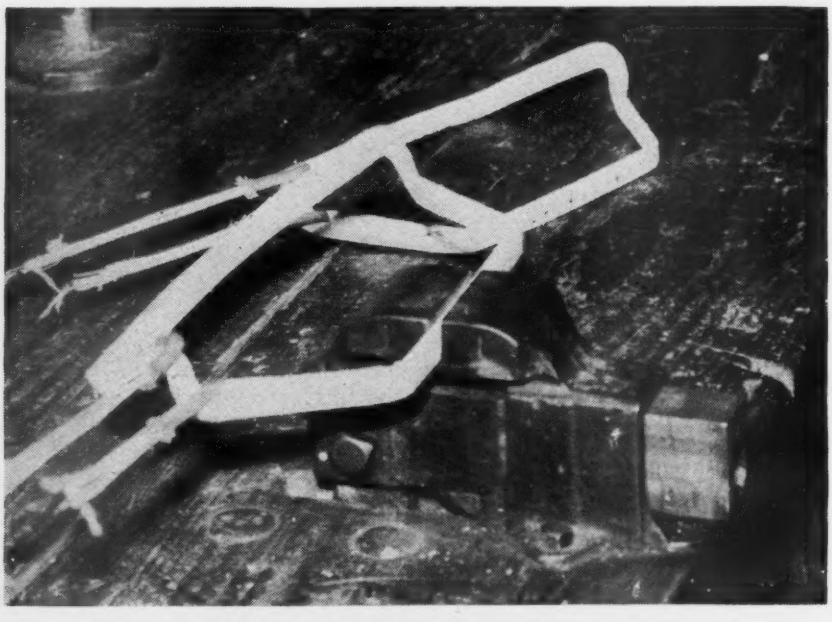
MOTOR SHOPS

COIL KICKER RECLAIMS COPPER

An ordinary machinist's bench vise was remodeled into what the Best Electric Co. of New Orleans, motor service shop, calls a "coil kicker"—a device used primarily to square up wound coils so they will fit easily into stator slots, and to remove kinks and straighten out used rectangular and flat copper coil sections.

The transition was simple. The ordinary hand screw adjusting lever of the vise was removed and replaced by a foot-operated lever attached to the movable vise jaw. The foot lever, with its pivot point on the underside of the bench, is equipped with a retaining spring which pulls the vise jaws open after pressure is released. To prevent damage to the coils and copper, the serrated face plates of the ordinary vise were removed and replaced with smooth steel plates. A guide plate bolted to the underside of the stationary jaw prevents the coils from dropping through the jaws.

The coils are inserted in the jaws and slide along while the operator applies and releases pressure on the foot pedal. Each application of pressure shapes up the coil section or straightens kinks in the old copper run through the device. The 2½-inch vise jaws are small enough to permit the operator to work on coil crossover and end sections also. This operation is usually performed just before the coils are placed in the slots and may be substituted in some degree for hot presses used in some shops.

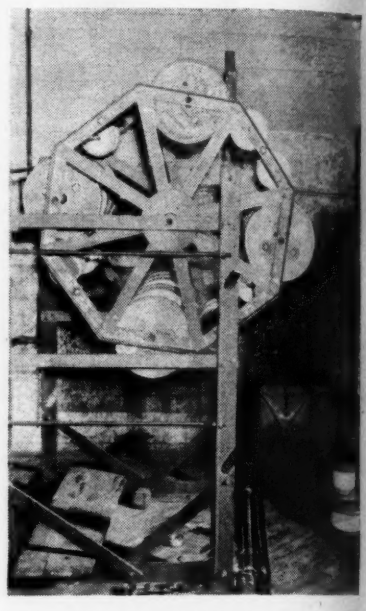


***KINKS ARE REMOVED** from old copper and new coils are squared into slot shapes by this remodeled machinist's bench vise. Foot-operated lever arm with spring return actuates the movable vise jaw. Vise is sufficiently small to permit working on coil ends.*

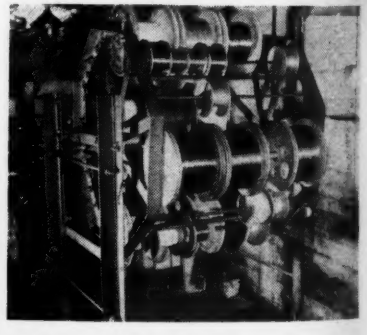
MAGNET WIRE PAYOUT WHEEL

Around she spins and when the desired size comes up you stop the wheel, anchor it, and there you are—all set to go about your winding business. That's the routine the boys in the motor service shop of the Wm. C. Krauth Electric Company, Louisville, Ky., follow—that is, since they have designed and built a unique Ferris-wheel type of magnet wire rack that accommodates approximately 40 reels of wire, depending upon the size of the reels.

Supporting the revolving wheel is a 5-ft. tall angle iron frame consisting of 3-in. by 3-in. by ¼-in. angle iron uprights with flat iron and bolt rod braces. This frame is firmly anchored to the floor and by horizontal braces to one wall of the winding room. The uprights are fitted with cutouts to accommodate rods with heavy magnet wire reels. The lower two sets, 18 inches above the floor, can be used with the revolving wheel in place. To use the upper two sets, 44 inches above the floor, the wheel must be removed.



***REVOLVING PAYOUT** wheel for small magnet wire reels speeds up the winding operations in this Louisville motor service shop. Wheel accommodates approximately 40 different sizes and types of reels.*



***CLOSE UP** of the Ferris-type payout wheel showing its construction details and the method of mounting the magnet wire reels. Note the double row for smaller reels.*

The revolving wheel is 39-in. in diameter and 29½-in. wide. The two rims of this squirrel-cage are fashioned from single lengths of 2-in. by 2-in. by ¼-in. angle iron bent into an octagon shape and fastened to 9-in. diameter hub plates by 2-in. by 2-in. by ⅜-in. flat iron spokes. Four sides of the wheel each have one rod to hold three or four 12-in. magnet wire reels,

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YES, THE CROCKER-WHEELER field engineer has an ear to the ground and an eye to the future. Not a miracle man, but thoroughly educated in engineering and with years of experience in the application of motors and generators.

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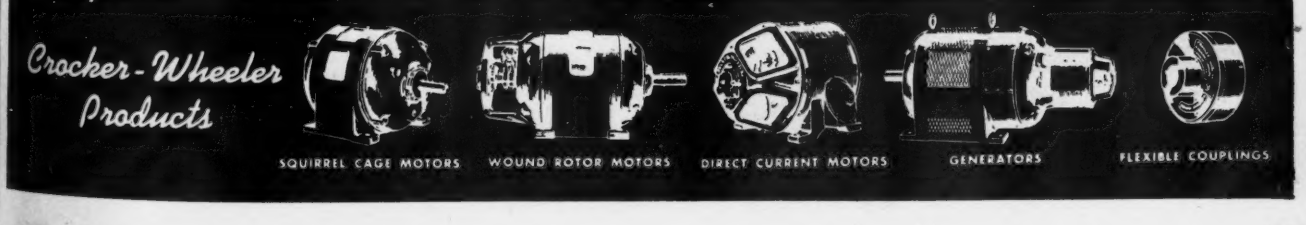

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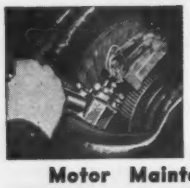

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depending on the width of the reel. The other four sides (alternate ones) each have two rods to hold double rows of 6-in. reels. The entire wheel revolves about a shaft mounted to the top cross brace of the frame, about 7½ inches from the right hand uprights—adding to the stability of the unit when the wire is pulled through the tension device mounted on an angle iron support to the left hand uprights.

After the desired sizes of magnet wire have been chosen for a particular winding job, the wheel is locked in a stationary position by a long bolt rod placed between the wheel spokes and the two upper cross braces of both sides of the supporting framework.

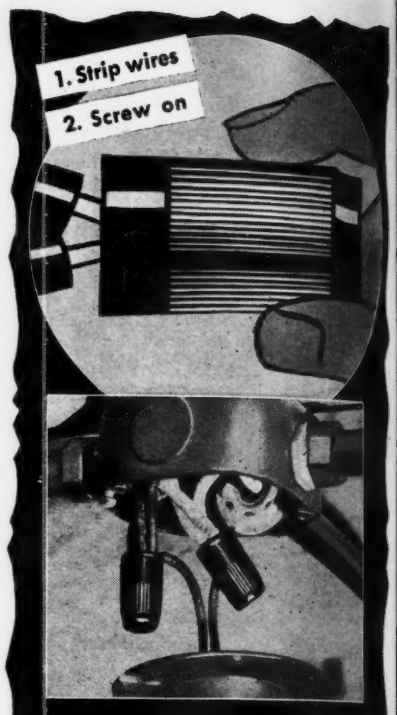
Not only does this unique device solve the problem of digging out various sized magnet wire reels when they are needed, but it also solves the reel storage problem to a marked degree. The net result is a more efficient winding operation.

FRACTIONAL MOTOR WINDING SADDLE

Simple gadgets often do the job as well or better and are generally used much more than complicated equipment specially built for specific operations. Electrical Equipment Company of Richmond, Va., has several screw-down portable vises specially built for holding fractional stators during winding operations. However, they are seldom, if ever, used any more since one of the boys picked up an idea for a fractional motor stator saddle.

Two pieces of four by four inch angle iron six inches long are backed-up vertex to vertex and welded solidly

FRACTIONAL MOTOR stator saddle for holding stators in place during winding operations is made from two pieces of four inch angle iron welded solidly together.



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together by two continuous beads, one on each side. That's all there is to it. The stators neatly rest in the V while winding. In this manner the stator can be turned at the discretion of the worker without a lot of tightening and untightening. Nor is there any superstructure, such as an adjustable arm for clamping the stator, which might hinder the operation of the winder.

All the shop workers swear by it and use is almost exclusively.

NO. 4: FIELD COIL WINDING TERMS

By A. C. ROE

Design Engineer, Westinghouse Elec. & Mfg. Co.

When designing or winding field coils, the major problem is the arrangement of the starting and finishing leads, the number of layers, the taper, etc., to provide the most satisfactory mechanical fit in the field frame.

The polarity of the main and commutating-pole field coils for a four-pole, series mine motor, with two commutating poles, is shown in Fig. 1. This is the standard type of wiring diagram used to show the proper coil arrangement, polarity, and connections between coils. This type of diagram is generally called a wiring-around-frame diagram (W.A.F.)

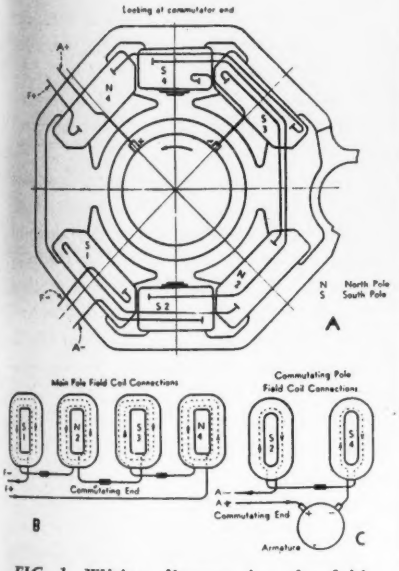

FIG. 1. Wiring diagram for the field coils of a mine motor.

In Fig. 1A are shown the coils as they would appear in the frame. Looking at the commutator end, this diagram definitely locates the polarity of each main and commutating pole, and the polarity of brushes in relation to armature rotation. It also indicates how the connections between coils are made.

The coils are shown in Figs. 1B and 1C as they would appear when laid out

[Continued on page 134]

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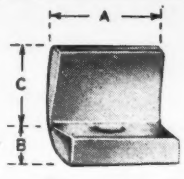
RENEWAL PARTS GUIDE

CUTLER·HAMMER MOTOR CONTROL C-H



A	B	C	Part No.
½ in.	⅞ in.	⅞ in.	1321-1624
¾ in.	⅞ in.	⅞ in.	1321-1647
1 in.	⅞ in.	⅞ in.	1321-1617

Typical Illustration from the Renewal Parts Guide

Each part is shown in "lifelike" perspective so it can be easily matched up with the part to be replaced. Full dimensions are given to assure accurate part order number.

WARTIME production imposes staggering demands on Motor Control and the men who keep it going. Thus the job of ordering renewal parts must be reduced to its simplest terms. This is just what the new Cutler-Hammer Renewal Parts Guide does for you.

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CUTLER·HAMMER MOTOR CONTROL C-H

Answered by
F. N. M. SQUIRES
Chief Inspector New York Board of Fire Underwriters

QUESTIONS ON THE CODE

INSULATED SCREW-HEADS

Q. *"Would like to have you give us an official ruling on the following:*

1.—Install insulated-head screws for switch and device plates installed in conjunction with non-metallic sheathed cable and metallic outlet boxes within reach of any grounded surface as required by N.E.C. Section 3707.

(Note: This violation was ordered by a Federal Inspection Officer in connection with a housing project now in process of completion. The metal boxes were properly grounded).

We took this section up with the Local Office of the Inspection Bureau and they advise us that the above is only applicable to locations where non-metallic outlet boxes are used and does not apply to grounded metal boxes, which is right?"—A.W.H.

A. First let us reiterate that the answers in this column are not "official" interpretations, but are only the opinions of the editor of this column. For an "official interpretation" of the requirements of the National Electrical Code, the instructions in the Appendix to the code (page 345), must be followed. This states that "those desiring an interpretation shall supply the Chairman (of the Electrical Committee N.F.P.A.), with five identical copies of a statement in which shall appear specific reference to a single problem, paragraph or section (of the Code)".

As to the above question, the last sentence of paragraph 3708b concerns the screws and exposed screw heads used to secure the covers of *non-metallic* boxes. If grounded metal boxes are used, no question arises as the grounding is considered as eliminating any hazard. But, if screws are used with the covers of non-metallic boxes then precautions must be taken.

If any parts of the screws or any metal connected with the screws are exposed within the box, or between the cover and the box, then the exposed screw heads must be covered with non-metallic (insulating) material.

In many non-metallic boxes no parts of the screws nor the threads into which the screws thread, are exposed. The screws in these cases, thread into moulded composition or into metal threads imbedded in the moulded composition.

This latter condition meets the provision "that they cannot come into contact with live parts or live conductors in the box", as mentioned in 3707b.

***LAB SESSION** in electronics, at the Illinois Institute of Technology, gets the undivided attention of Chicago electrical contractors (L to R) Leo Witz, A. F. Smith, Al Oppenheimer, and T. F. Kisken.*

ELBOW BENDS

Q. *"In your December issue under 'Questions on the Code' a question on bends in conduit prompted me to seek a clarification of a similar question. As I understand it, the Code differentiates between 'factory-made' and 'field-made' bends. For the first, the Code stipulates a minimum radius to the inside of bend of four times the diameter; and for the second, a minimum radius to the inside of bend of six times the diameter.*

"Now, the first question I should like to have answered is this: does the word diameter as used in the text refer to the actual inside diameter of the conduit or does the word refer to the nominal diameter?

"I have the tables of several conduit manufacturers, giving the radius both to the inside and to the center-line of bends of the various sizes. A study of these tables and a comparison with a table made up according to the apparent Code requirements does not check. What is the explanation for the discrepancy?

"Again the term 'field-made' in the Code limits the minimum radius to inside of bend to 'six times the diameter'. You are no doubt aware that most of the equipment available for making such bends makes it possible to form bends to radius approximately equal to radius to manufactured or 'factory-made' bends. If the intent of the Code is to outlaw all 'field-made' bends of a radius less than six times the diameter of the conduit, and regardless of the type of equipment used to produce them, am I correct in assuming that bends made to the minimum possible radius with portable bending equipment, on the job, and resulting in a radius of less than the required six times the diameter, would not be considered acceptable under a strict interpretation of the Code?

"I believe that this question is also tied up directly with another section of the Code; namely the section dealing with the '40 percent space-factor'. I can find nothing in the Code which requires that the shape of a wire-way or conduit be round. As a matter of fact

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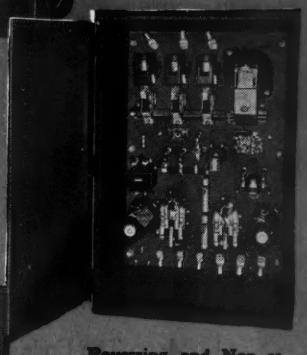

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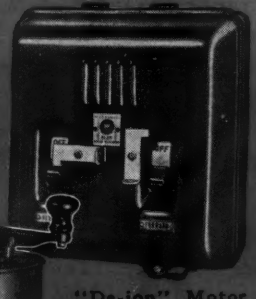
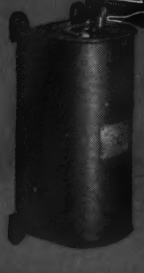
Manual Multi-speed Drum Controllers.

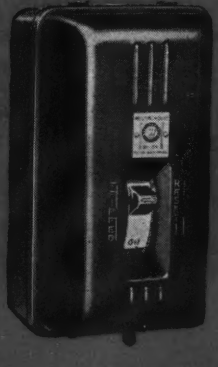


"De-ion" Motor Watchman Reversing and Two-speed Manual Starters.



Manual Multi-speed Drum Controllers.

Reversing Drum Controller for use with Primary Resistance.



Across-the-line "De-ion" Manual Motor Starter.

Small . . . but MIGHTY!

. . . this 3-POUND MIDGET "MEGGER"* TESTER generates *500 VOLTS* and reads up to 50 Megohms

Basically designed for maintenance men, this mighty midget is used by many engineers for testing insulation resistance of practically all types of electrical equipment. Because it is small enough to fit an overcoat pocket or tool kit, and because of its instrument accuracy and machine ruggedness it has proved itself indispensable for maintenance and trouble shooting, even where higher range "Megger" sets are available. The hand cranked generator delivers 500 volts and since no batteries or external power supply are required, it is always ready for use . . . anywhere.

If you are not already familiar with this smallest and in many ways the most remarkable member of the "Megger" family, write for Bulletin 1545-EC and Catalog 1685-EC.

**Trade Mark Reg. U.S. Pat. Off.*

Ask also for Bulletin 1735-EC describing the new U. S.-made "Megger" Testers.

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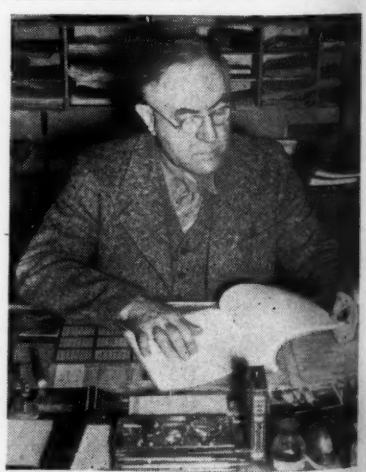
there are approved wire-ways which are designed in rectangular and oval shapes. Also, a given conduit size provides for a range of conductor sizes. Now, if a conduit is being used to contain the smallest group of conductors for which that particular conduit size is required, there is a considerable margin of space available.

"My next question, then, is this: If a piece of conduit, in the process of being bent is deformed from a true circular to an oval shape, but without injuring the surfaces of the conduit, and without creating any sharp ridges that might injure the conductors, if the resulting cross-section of such a bend meets the space requirements of a 40 percent space-factor, will the bend be acceptable?

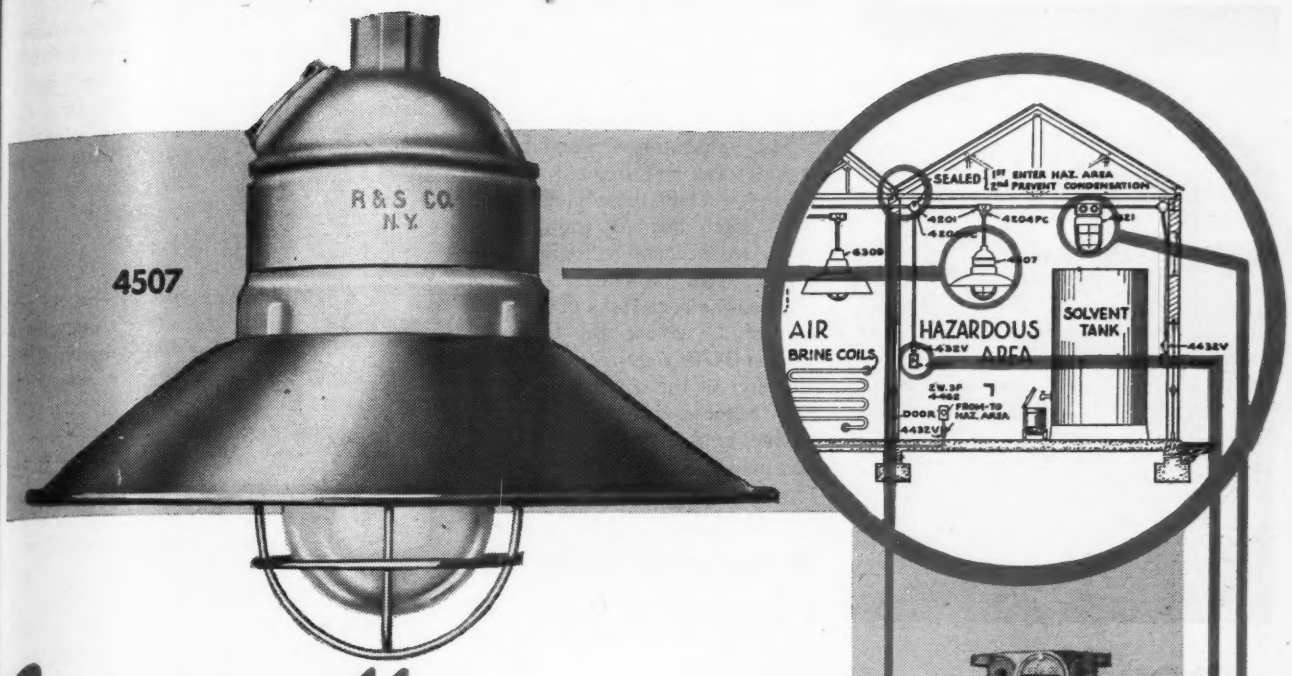
"Please understand that I am not advocating the making of bends according to the description outlined. I am merely seeking an interpretation of the Code on the points involved."—A.H.

A. The Code does differentiate between "field bends" and others such as factory or shop made bends in section 3490, in the belief that the workmen in the field will not always have the proper tools and facilities for making good smooth bends on the job. It is true that with some of the modern pipe bending apparatus just as good bends can be made in the field as in the factory and probably no inspector will object when the work is properly done.

However, the four-times radius mentioned by our inquirer for factory made bends is not given in the Code, but reference to Underwriters' Laboratories Standards for rigid conduit shows that the radius of the curve of the inner edge of a factory made elbow is not always six times the internal diameter of the conduit. For ½-in. con-



VETERANS' FRIEND, *Bob Nichols, president of Wisconsin Electrical Association and a Madison contractor has his postwar job all cut out. He represents Dane County Draft Board No. 2, Madison, on the committee for reemployment of returning World War II veterans.*



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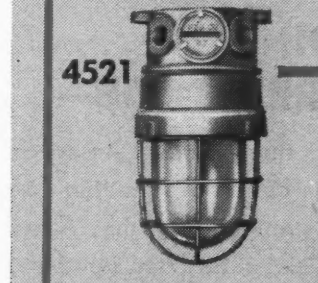

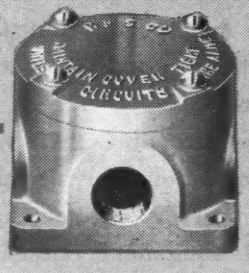

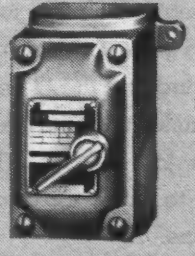

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duit it figures at 5¾ times, for ¾-in. conduit 4.8 times, for 1-in. conduit 4.8 times, for 2-in. conduit 4 times, for 3-in. conduit 3.6 times, for 4-in. conduit 3.2 times, and for 6-in. conduit 4.4 times.

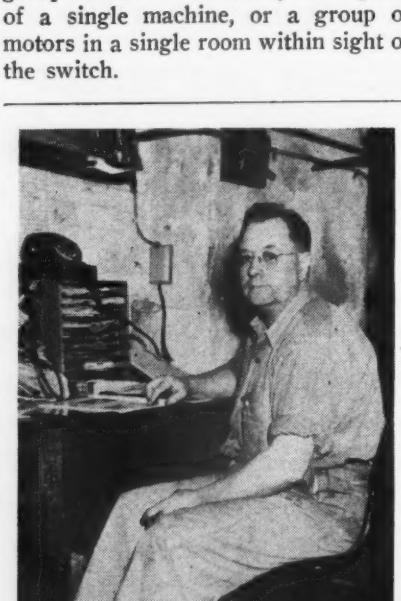
The Laboratories Standard does not include the requirement for a wire pulling test but these factory made elbows, each bearing the Laboratories label, are acceptable to inspection departments in the field.

As to the roundness of the cross section of the elbow, the Code does, in section 3470, require that the internal diameter of the conduit be not materially reduced in bending. This, of course, is to insure that the 40 percent area will still be available for the wires.

SINGLE DISCONNECTING MEANS

Q. 1. *"In a 220 volt 3 phase installation being served by a delta connected service with one leg having more than 150 volts to ground, would the fusing of several circuits under the control of a single disconnecting means, violate Section 2440?"* —E.M.McE.

A. 1. Yes, except where the disconnecting switch serves a group of motors which may drive parts of a single machine, or a group of motors in a single room within sight of the switch.



E. A. KELLETTE, electrical engineer for Clinard Electric Company, who saw plenty of action in the first World War is now debating on a naval commission offered him in World War II. An expert on motor winding and having redesigned various types of electrical machinery for Winston-Salem industrials, Mr. Kellette has thus far been persuaded by his boss B. C. Clinard that his services are indispensible to the production front.

Q. 2. *Under the same conditions, would grouping several small motors under one disconnect switch comply with Section 4410, when (1) each motor operates an individual machine and (2) each is protected by separate fuses? There is no objection to all motors being shutdown for removing or replacing fuses.*

A. 2. If all of the motors are within the same room and are within sight of the single disconnecting means, this arrangement would not violate Section 4410.

Q. 3. *"If motors are not within sight of the disconnecting means, and same conditions as above apply, would section 4410 be violated?"*

A. 3. Yes, if all of the motors are not within sight of the disconnecting means, there would be a violation of Section 4410.

PLUG FUSES NOT FOR 220 VOLTS

Q. *"Can plug fuses and cutout base be installed for 220 volt motor circuits?"*—H.L.G.

A. Until the 1935 Code, Rule 803e permitted plug fuses (which are rated at 125 volts) to be used on any feeder or circuit of a system having a grounded neutral provided no wire exceeded 150 volts to ground. This permitted small 220 volt motors to be protected by plug fuses.

This is no longer permissible as Section 9240J states, in effect, that fuses with spacings for 125 volts may be used only in 2 wire 125 volt branch circuits.

OFFICIAL INTERPRETATIONS

by the

Electrical Committee of the N.F.P.A.

Interpretation No. 250

STATEMENT . . A city-owned and operated constant-current system street lighting circuit is run exposed under sidewalks in basement areas of private premises. Lead cables are in rigid conduit. The lead sheath, the conduit, and lamp posts are bonded and grounded.

QUESTION . . . Is it intended that section 7104 shall apply to these circuits when no use of current and no access to cables or lamp post base compartments is provided within the premises?

ANSWER . . . No. This section applies to a wiring system for consumer premises.

* BETTER WIRING FOR BETTER LIVING *

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YES, the door to the Westinghouse Better Homes Department is *always open* to assist the building profession in the planning of postwar housing.

The Better Homes Advisory Staff is ready and eager to give authoritative technical advice on the *proper applications of electricity* in 194X homes.

SIX-POINT ADVISORY SERVICE

The Better Homes Department offers a *Six-Point Advisory Service* on the following subjects:

1. Selection of correct types of electrical equipment for various classes of postwar homes.
2. Location and arrangement of fixed equipment, for conserving space and attaining maximum efficiency in arrangement of work cycles.
3. Accurate dimensions and clearances of equipment to insure proper installation and efficient operation.
4. Access for servicing of equipment—so necessary for periodic inspection and repair.
5. Location of lighting outlets and controls, for greater enjoyment, comfort, and safety in the home.
6. Utility service connections—including location and size of electric wiring, water supply, and drainage.

Westinghouse Better Homes Department welcomes the opportunity of giving constructive assistance to those interested in postwar housing.

If you have any problems relating to the selection, installation, and use of home electrical equipment, write: Better Homes Department, Westinghouse Electric & Manufacturing Company, Pittsburgh 30, Pennsylvania.

"ELECTRICAL LIVING IN 194X"

The Better Homes Department is preparing a new and unusual book—"Electrical Living in 194X" — which explains the urgent need for *better wiring for better living* in postwar homes.

This new book will be very helpful to the building profession and allied interests . . . in explaining to prospective home owners the importance of better wiring in their 194X homes.

"Electrical Living in 194X" will be made available to contractors, builders, architects, engineers, public utilities, housing authorities, electrical inspectors, building management, and investment institutions.

Watch for further announcements regarding this colorful, easy-to-understand, 64 page book!

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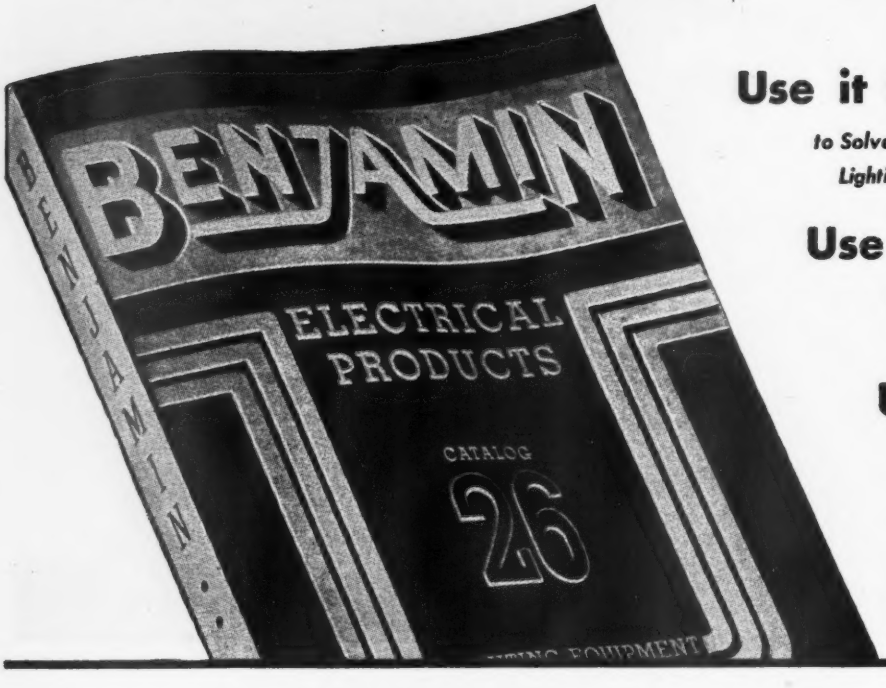

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Selection of Motor Drive

A general guide to facilitate the selection and application of motor drive to industrial operations.

A GREAT many factors are involved in the correct selection and application of motor drive. While the most important aspect is the motor operation; installation and maintenance factors must also be carefully considered. Space limitations, ventilation and ambient temperatures affect the installation decision, while such considerations as accessibility for lubrication, test and inspection must also be taken into account.

Efficiency, power-factor, torque, horsepower, speed, voltage, starting characteristics, etc., are the basic operating considerations that largely determine the motor rating.

As a general rule, certain disadvantages must be accepted in order to gain certain advantages. With few exceptions, any selection is a compromise. For instance, a slow speed motor may be required to enable direct connection because of space limitation and to eliminate reduction losses. This is accomplished however, by accepting the inherently lower power-factors and efficiencies of slow speed motors.

SELECTION POINTS

A.C. or D.C.	[Starting Current
Horsepower	Starting Torque
Duty Cycle	Running Torque
Speed	Temperature
Voltage	Insulation
Frequency	Enclosures
Phase	Bearings
Efficiency	Mounting
Power Factor	Coupling
Space Limitations	Special

This is the first of a series on motor selection, and is of a general nature covering all types. Subsequent articles will deal separately with the individual types, their control application, characteristics, and other factors that determine the motor suitable for a specific type of drive.

Thus, through careful study of the characteristics of various types of drive, selection can always be made to the best advantage.

Voltage and Frequency

The voltage rating of the motor is generally dictated by the plant distribution system. If both d.c. and a.c. are available, then a much wider range of drive is provided from which to choose. Certain cases of critical drive requirements may necessitate the installation of d.c. power in an area where only a.c. is available. In such a case, conversion can be obtained with motor-generator sets, rectifiers or converters. However, these cases are few and exceptional. Where two voltages such as 120/208 volts are available, it is generally more economical to operate 3 phase at the higher voltage. Where large motors are being installed voltages of 2200, 4000, or 6600 may be advisable.

In order to use a standard motor, utilization voltage must be maintained within plus or minus ten percent of the nameplate rating; otherwise special motors may be required. Induction motors of 220 volt design will operate satisfactorily on the common network 208 volt, 3 phase system but not at guaranteed performance values.

Frequencies are dictated by that of the distribution system; however, special high-speed motor applications may warrant the installation of frequency changers.

For a.c. operation, three phase is the most desirable and most economical. Two phase is found only in few scattered areas. Single phase motors are limited in size but are suitable for most residential, rural and commercial applications where only single phase is available.

Motor Size

When space limitation is a governing factor, it is well to remember that the motor frame size is determined by several factors including horsepower, speed, temperature (ambient and rise), and voltage. The most important factor is the horsepower. If the horsepower requirements are not known and cannot be calculated, the manufacturer of the driven machine can generally supply the necessary data. Or, as a last resort, a temporary hook-up can be made and by taking electrical meas-

ENCLOSURES

- Open
- Drip-proof
- Drip-proof, fully enclosed
- Splash proof
- Totally enclosed, non-ventilated
- Totally enclosed, fan-cooled
- Explosion-proof
- Separately ventilated
- Enclosed, self-ventilated
- Enclosed, separately ventilated

PREFERRED HORSEPOWER LIMITS

Phase	Nominal Voltage	Minimum Horsepower	Maximum Horsepower
Single	110	None	1½
	220	None	10
	440–550	5	10
Two and Three	110	None	15
	220	None	200
	440–550	None	500
	2200	40	None
	4000	75	None
	6600	400	None
D.C.	115	None	30
	230	None	200
	550–600	½	None

HORSEPOWER LIMITS: TWO-BEARING MOTORS: BELT DRIVE

Motor Speed rpm	Flat-belt Drive Max. hp.	V-belt Drive Max. hp.
1700–1800	40	60; ball brg. 75
1440–1500	40	60; " " 75
1150–1200	75	100; " " 125
850– 900	125	200
680– 720	200	300
560– 600	200	300
500– 514	150	300
440– 450	150	250

urements, arrive at the proper size required. Estimations of efficiencies and power factors will have to be made in order to make the calculations. (See page 69 *Electrical Contracting*, October, 1943.)

Speed

Motor speed is next in importance in determining frame size. For the same horsepower rating, a jump in speed from 720 r.p.m. (10 poles) to 3,600 r.p.m. (2 poles) will generally decrease the motor frame several sizes. In addition to the advantage of smaller frames, higher speed motors have much better efficiencies and power factors, which may have a very marked effect on operating costs.

The use of belts and pulleys or chain drive very often permit use of a higher speed motor where speed differences between motor and driven machine are not too great. However, where driven speed is exceptionally low, slow speed motors or gear motors may be required in the larger sizes.

For motors up to approximately 75 hp., standard gearmotors are available to permit use of the higher speed motors and to meet critical space requirements. Standard reduction ratios run from up to 5 to 1 for a single reduction gear unit to 200 to 1 for a triple reduction. The units can be supplied with either 900, 1,200, or 1,800 r.p.m. motors giving output shaft speeds over the range 4 to 1,550 r.p.m. Any of these units can be obtained with a.c. or d.c. motors, single phase or three phase, squirrel cage or wound rotor motors. They are built for either indoor or outdoor operation, and may be protected by any type of enclosure desired from the open type to totally enclosed and explosion-proof.

Gearmotors are becoming extremely popular because of their compact design for minimum space requirements; high efficiency and high power factor of the high speed motors; and high efficiency of power transmission.

The foregoing has pertained mostly to constant speed applications. Where adjustable speed or multiple speed is required on a.c., adjustable speed can be obtained by using the wound rotor motor or other types of a.c. adjustable speed drive. The main advantage of the wound rotor motor is its ability to start heavy loads with low in-rush currents and high starting torques.

Multiple speed squirrel cage motors can be obtained with multiple windings. That is, they have two or more sets of windings that can be reconnected for different numbers of poles resulting in two, three or four fixed speeds. Here it is important that horsepower and torque requirements be determined for each speed.

A comparatively new field is being developed rapidly in adjustable speed drive from a.c. lines. Alternating current is rectified by electronic tubes to d.c. which is supplied to standard d.c. motors. Single, two, or three phase distribution can be used to supply the electronic equipment. Successful applications have been made up to 25 hp. with promise of a much greater range coming.

Temperature Considerations

Again, where space limitations are critical, or ambient temperatures are higher than usual, class B insulation can be specified with a consequent decrease often of several frame sizes for the same horsepower rating.

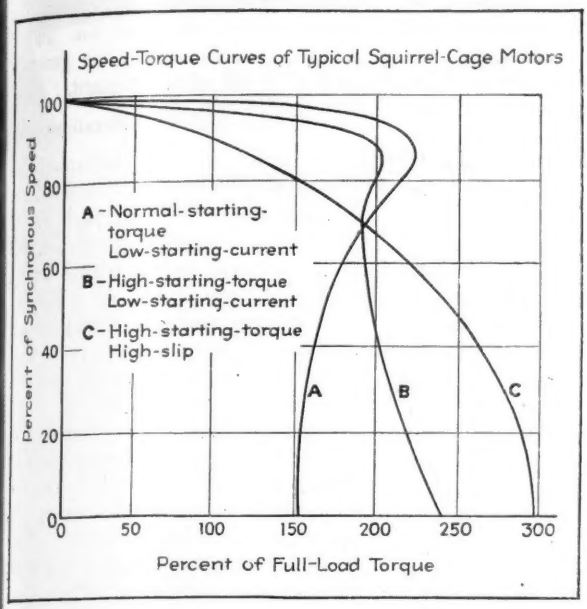
Motor insulation comes under two general classifications: Class A for normal temperatures and Class B for high temperatures. Class A insulation includes cotton, silk, paper and other organic material when impregnated or immersed in oil, and enamelled wire. If normal life for Class A insulation is to be obtained, the maximum temperature should never run higher than 105 deg. C. Thus with a 40 deg. C. ambient (surrounding air) temperature and using a standard open or partially enclosed motor rated at 50 deg. C. rise with an allowance of 15 deg. for hot spot the total temperature is 105 deg. C. Or with 40 deg. C. ambient, using a totally enclosed motor rated 55 deg. C. plus 10 deg. C. for hot spot gives 105 deg. C.

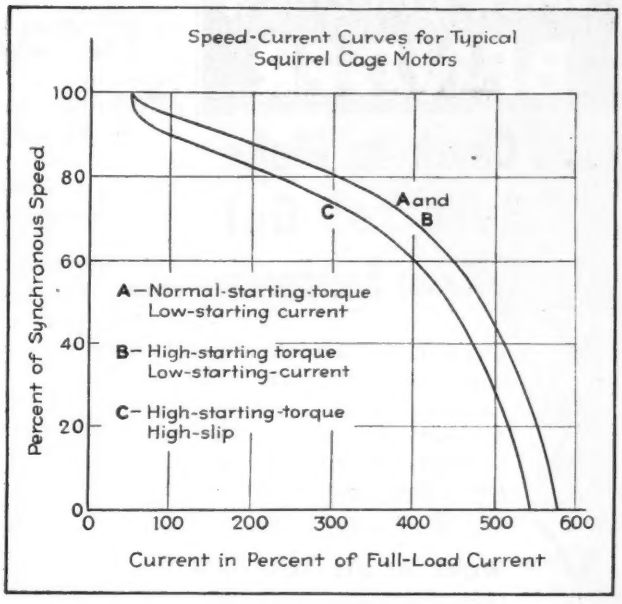
HORSEPOWER LIMITS: TWO-BEARING MOTORS: CHAIN DRIVE

Motor Speed, rpm	Maximum hp.
1700–1800	5
1440–1500	10
1150–1200	25
850– 900	50
720– 750	75

Class A insulation is ordinarily used even for ambients above 40 deg. C. As an example, suppose that the ambient is 60 deg. C. Then for an open motor 15 deg. C. would be allowed for the hot spot, leaving only 30 deg. C. rise allowable. So a 30 deg. C. rise motor would be specified (at increased cost generally). Advantage, however, is derived from the fact that low temperature rise motors have comparatively high efficiencies because of the larger amount of copper required to get the lower temperature rise.

Class B insulation includes such inorganic materials as glass, mica, and asbestos. Its maximum operating temperature for normal life is 125 deg. C. Thus a 40 deg. C. ambient permits a rise of 70 deg. C. or 75 deg. C. depending upon the type of enclosure. Or vice-versa with a 55 deg. C. rise motor an ambient of 55 deg. C. or 60 deg. C. would be permitted. So, as far as temperatures are concerned, a wide range is available to meet any specification.




Speed-Current Curves for Typical Squirrel Cage Motors
Percent of Synchronous Speed
A and B
C
A - Normal-starting-torque Low-starting current
B - High-starting torque Low-starting-current
C - High-starting-torque High-slip
Current in Percent of Full-Load Current

Duty Cycle

The complete duty cycle of any drive plays an important part in horsepower rating. With a duty cycle that includes sustained peaks (varying from 15 minutes to 2 hours) the motor hp. rating will usually not be less than this constant peak value regardless of other parts of the cycle.

In cases where the load varies considerably over a narrow range, horsepower requirements can be determined by the root-mean-square method to determine the rating from an equivalent heating standpoint.

Running Torque

For adjustable speed d.c. applications either a constant-torque or a constant horsepower drive may be obtained. A constant-torque drive is one that operates at constant torque throughout its speed range with varying horsepower. A constant-horsepower drive is one that operates at constant horsepower throughout its speed range with varying torque.

A d.c. motor operating with constant field excitation and with the armature supplied from a variable-voltage source is a constant-torque motor. On the other hand, an adjustable-speed d.c. motor having speed variation by means of shunt-field control is a constant-horsepower motor.

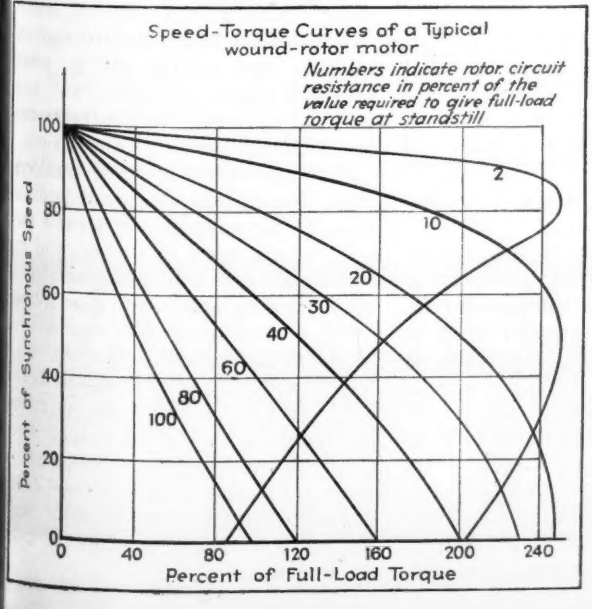
The running torque is determined by the horsepower and speed of the driven machine and at any given time the torque in pound-feet is equal to the horsepower times 5,250 divided by the speed in r.p.m. Thus it is seen that the peak horsepower determines the maximum torque required by the driven machine. In order to avoid stalling, the motor must have a breakdown torque in excess of this value.

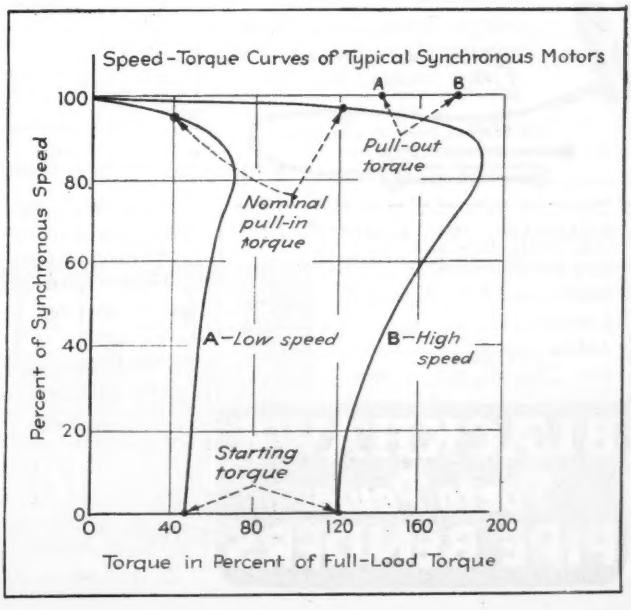
Driven machines such as the reciprocating compressor with pulsating load torque should be provided with a flywheel effect (WR^2) to prevent excessive pulsations in the line current of the motor.

Starting Torque

Starting torques (sometimes called breakaway torques) may vary from as low as 10 percent for a fan or centrifugal pump load to as high as 225 or 250 percent of full load torque for fully loaded reciprocating compressors or hydraulic pumps. The motor torque available at the shaft should be well above the torque required by the driven machine in order to overcome such varying conditions as temperature changes, lubricants and the possibility of low voltage at the motor terminals at the time of starting.

After breakaway, the torque requirements for acceleration to full speed varies considerably with different


Speed-Torque Curves of a Typical wound-rotor motor
Numbers indicate rotor circuit resistance in percent of the value required to give full-load torque at standstill
Percent of Synchronous Speed
Percent of Full-Load Torque



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BENDER
. . . Check to Make Sure You Get *These* Features

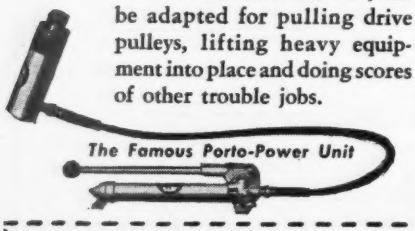
EASY TO GET TO THE JOB
Lightweight and portable, one man can easily carry or roll any Blackhawk Pipe Bender right to the job. Saves time and manpower. Bend rigid conduit and pipe up to 4".

WORK AT ALL ANGLES
Compact hydraulic Porto-Power ram of Blackhawk Pipe Bender works in all directions. Unique design. Avoids kinking. Power eliminates need for heating.

WORK OVERHEAD
All-directional operation and light weight permits work on existing pipe runs.

SIGHT FROM ANY ANGLE
Remote control permits operator to stand in any position necessary to give him full view of job. Blackhawk Benders save need for elbows and couplings and otherwise necessary cutting and threading.

DETACHABLE POWER UNIT *for Extra Utility*
This unit (the heart of the bender) with special available Porto-Power attachments, can be adapted for pulling drive pulleys, lifting heavy equipment into place and doing scores of other trouble jobs.



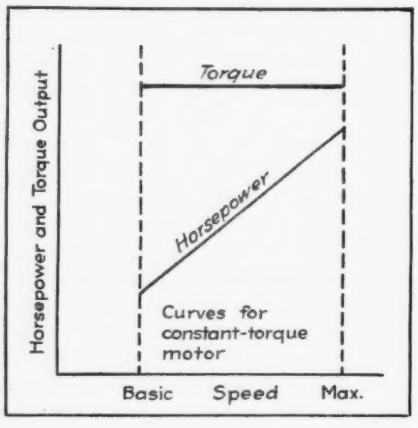
BLACKHAWK MFG. COMPANY
Dept. P2024, Milwaukee, Wis.
Send full information on your pipe benders.
Name.....
Company.....
Address.....
City..... State.....

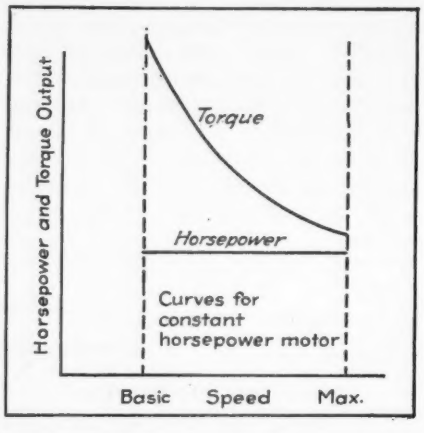
BLACKHAWK
Porto-Power
PIPE BENDERS

types of machinery. But regardless of what it is, the torque delivered by the motor must at all points up to full speed be in excess of the torque required by the driven machine. The greater this excess torque, the faster will be the acceleration. If the time to accelerate is greater than about 20 seconds, a special motor and starter may be required to avoid excessive heating.

Starting torques of the squirrel-cage motor varies from the so-called normal starting torque motor with 150 percent starting torque (in percent of full-load torque) to the high starting torque high-lip motor with almost 300 percent.

The typical wound-rotor motor can muster up to about 250 percent starting torque with the proper amount of starting resistance in the rotor circuit. The great advantage of the wound-rotor motor lies in the fact that it can obtain a high starting torque at a relatively low starting current.





Adjustable speed may be obtained by a wound rotor motor but generally at quite a sacrifice in efficiency due to the large amount of energy that must be dissipated in the rotor resistances at lower speed settings.

The typical starting torque of the synchronous motor varies from some 45 percent for a low speed drive to about 120 percent for a high speed motor.

The d.c. shunt wound motor has a medium starting torque varying from 125 percent to 200 percent. The compound wound motor has a high starting torque of 130 to 260 percent. The series motor develops the highest starting torques of any but generally limited to 300 to 350 percent.

Mechanical Considerations

The most important mechanical consideration is that of enclosures. Refer to Data Sheet K-1 on page 115 of *Electrical Contracting*, November, 1943 for a complete listing with definitions of the various types of enclosures. Surrounding conditions always dictate the type of enclosure; that is, damp, corrosive, explosive, dusty, outdoors, in a position where fluids or objects may fall on it, etc. Also, of importance is relative position of operation: horizontal, vertical or tilted. Very often the position at which the motor operates determines the type of bearing specified; whether it should be a thrust bearing, sleeve, ball or roller. Load, speed and method of coupling are of importance in bearing selection.

Coupling

Direct connection should always be considered when driven and driving speeds match. Very often, by use of gear motors, they can be made to match. Built in construction is often advisable where the motor frame can be bolted directly to the driven machine by means of a flange.

In belt drive, diameter and pulley face dimensions, and center distances are factors in determining bearing pressure and shaft deflections. Flat belt speeds should not exceed 5,000 feet per minute.

Chain drive is another possibility of load-to-motor coupling.

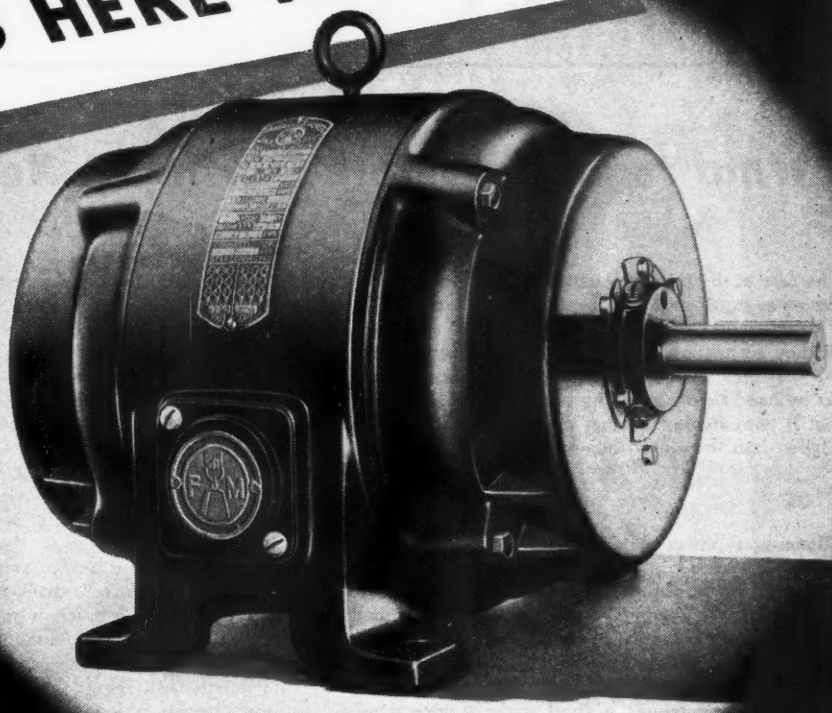
Where an ordinary spur-gear pinion is mounted on the motor shaft, two bearing motors should be limited to the horsepower ratings applied to chain drive.

Other mechanical considerations include double shaft extensions, tapered shafts, longer than standard shaft extensions and alemite fittings, grease cups, oil gages, end play, extra leads for dual voltages, bearing thermostats, special mountings and dimensions.

Although most of these considerations are classed as special modifications by the manufacturer (that is, they are not included in the price of the standard motor), their specification is very often necessary, and generally the extra cost can be easily justified from an economical standpoint.

Subsequent articles in this series will deal with individual types or groups of motors with respect to their characteristics and control. A better understanding of the advantages and disadvantages of all types of motor drive will lead to better selection of drive equipment.

TOMORROW'S MOTOR IS HERE TODAY!



WITH *Copperspun* ROTOR

YOU can buy this new postwar designed Fairbanks-Morse motor now—*knowing* that it will be just as modern—just as efficient—just as up to the minute in years to come as it is today.

It is indeed a challenge to the future—in efficient motor design.

- It is a 40°C. motor.
- It is a protected motor!
- It has the most adaptable, convenient, and handiest conduit box you ever laid your eyes on!
- It has the famous Fairbanks-Morse COPPER-SPUN Rotor!

Important!

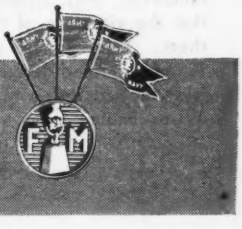
Never before has there been more stamina—more protection—more versatility built into a motor housing. A demonstration is necessary to fully appreciate how much this motor can really offer you. See it and judge for yourself.

Write Fairbanks, Morse & Co., 239 Fairbanks-Morse Bldg., Chicago 5, Ill.

FAIRBANKS-MORSE

DIESEL ENGINES
PUMPS
MOTORS
GENERATORS
WATER SYSTEMS
SCALES
STOKERS
FARM EQUIPMENT
RAILROAD EQUIPMENT

Motors



DATA SHEET

The number at the right is a classification for convenience in filing and for a future data sheet index.

K-3

What to Check Before Starting A New Motor

A little extra care at the time of installation is a good investment. For example, trouble may be avoided by a look at the brushes of a direct-current or single-phase repulsion motor to make sure that they are seating properly on the commutator, and with the proper pressure. It is also always good practice to turn the motor over by hand before applying power for the first time, to be sure that it turns freely and that no foreign materials or objects have fallen into the motor during shipment or handling.

Lubrication

Many fractional-horsepower motors have waste-packed bearings with a full charge of oil in them when shipped. Integral-horsepower motors (one-horsepower and larger) are usually shipped without oil in the bearings. In every case, make sure that the motor has its proper supply of bearing oil before power is applied. If equipped with an oil filler gage it should be approximately three quarters full of oil with the motor stopped.

For average indoor temperatures, a good grade of mineral oil with a viscosity (resistance to flowing) of 250 to 350 seconds Saybolt at 100 F. should be used. However, oil with a viscosity of 150 to 200 seconds Saybolt at 100 F. may be used for motors which are coupled directly to the load, having speeds between 1500 and 3600 rpm. with possibly lower bearing temperatures. (For convenience, the above viscosities correspond respectively to SAE No. 20 and SAE No. 10). Turbine oil should be used, not automobile oil.

Integral-horsepower polyphase and direct-current motors are often equipped with oil-ring bearings. When a motor with this type of bearing is first started, each bearing should be checked immediately, through the inspection opening to make sure that the ring is turning.

Ball-bearing housings are generally packed with grease when shipped, and hence require no lubrication at the time of installation. However it is well to check.

Pulley

Severe pounding, to drive a pulley or coupling on the motor shaft, may cause a bent shaft or damage to the bearings. A little care in removing paint from the shaft and light filing of any rough spots on the shaft, key, and pulley bore should eliminate the need for any heavy blows.

Electric Connections

On smaller motors, it is sometimes good policy to make the electric connections to the motor before bolting it into place. Thus, if any loose part falls into the motor, it may be easily removed. All connections should be made tightly enough so that the vibration of the equipment will not be able to loosen them. Wires joined in a conduit box should be either twisted together and soldered, or bolted together. These joints should be wrapped first with rubber tape, and then with friction tape. Wires issuing from a conduit box, especially rubber-covered extension cords, should be supported so that there is no strain on the connections themselves. Usually a knot in the wire inside the conduit box, or the use of conduit-box fittings that grip the wire where it leaves the box, are the most convenient ways to obtain this strain relief. Many fractional-horsepower motors are equipped with terminal boxes that are made so that they will grip the wires issuing from them.

It is good practice to check the motor nameplate to make sure that the motor has the correct horsepower, voltage, and frequency rating for the job. The nameplate stamping should agree with the power supply available. If the motor is rated for two voltages, it is well to check that it is connected for the proper voltage. The proper connections may be shown on a motor terminal plate, in a diagram on the inside of the conduit-box cover, or in the instruction book that accompanies the motor.

All motor and control wiring should be installed carefully in accordance with the National Electrical Code and any local requirements, and should have sufficient capacity to carry the full-load current with a maximum voltage drop of 2 percent of the line voltage. Motor frames should be grounded in accordance with the Code.

Starting

Leave the motor disconnected from the load for the initial start, if possible, particularly if direction of rotation is important to the driven apparatus. It is desirable to operate the motor without load for about an hour, if possible, to test for an unusual localized heating of the bearings or windings.

If direction of rotation is wrong, the instruction sheet accompanying the motor usually gives full instructions on how to correct. For three-phase motors, reverse any two leads. For two-phase motors, interchange lines of either phase.

CHECK

1. Nameplate data
2. Connections
3. Commutator
4. Brush seating
5. Spring tension
6. Oil levels
7. Oil ring
8. Rotation
9. Excesive heating

(in trial run)

Information from General Electric Co.

Take a Look at TOMORROW— *Today!*

"This Century Motor contributes a lot to the comfort of air conditioning."

Dependable CENTURY MOTORS Provide Quiet Starting and Quiet Operation for Blowers and Fans

The smooth, quiet starting, accelerating, and running of Century specialized motors for fans and blowers is one of the features that contributes to greater customer satisfaction. Among the other advantages of Century Motors are these: unusual freedom from mechanical and electrical vibration, Century's unique bearing bumpers that reduce chatter from V-belt irregularities, and cushion base mountings (available on motors of 3 horsepower and less) that isolate any possible vibration from your installation.

Century offers a wide range of specialized motors for not only blowers and fans, but also unit heaters, compressors, pumps—in fact, any heating, cooling, or ventilating application. They are available from fractional to 600 horsepower, in frames and electrical characteristics to meet the demands of every job.

For today—and tomorrow, investigate Century Motors for all your requirements.

CENTURY ELECTRIC COMPANY

1806 Pine Street, St. Louis 3, Missouri

Offices and Stock Points in Principal Cities

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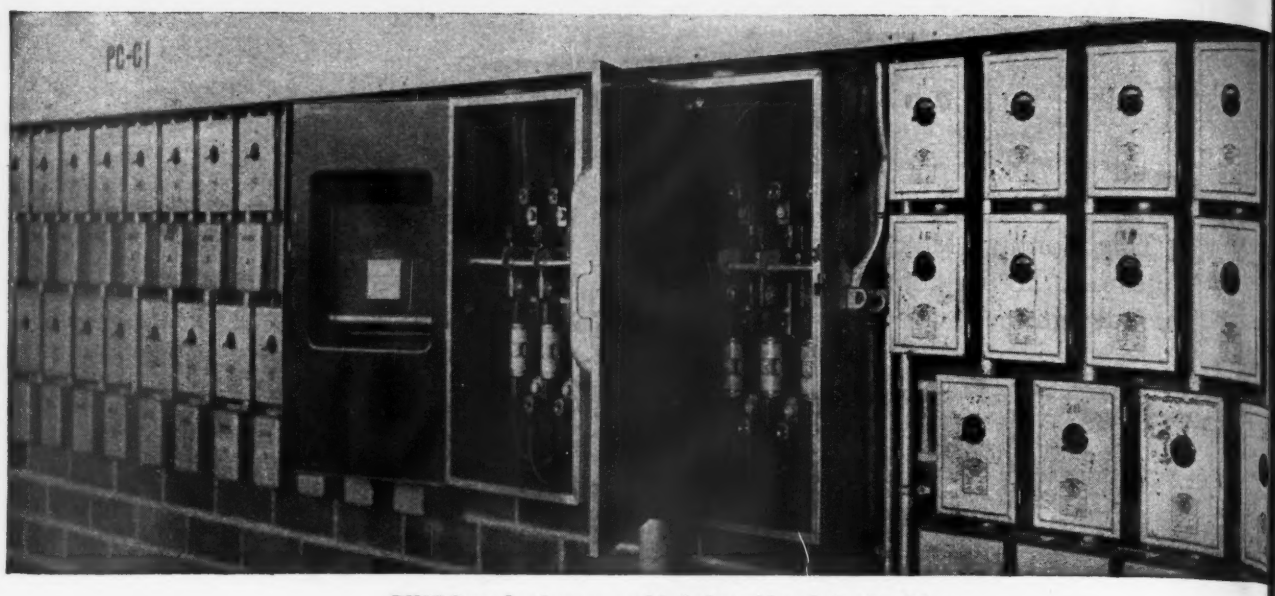


BUSS Super-Lag fuses are used in feeder and branch circuit switches.

Needless Motor Shutdowns Decreased Where We Installed BUSS Super-Lag Renewable Fuses"

Says Mr. Frank M. Herrick, Chief Engineer, Minnesota Valley Canning Company, Le Sueur, Minnesota

"Our canning operations are tough on fuses," continues Mr. Herrick, "because our operating season is so limited we operate 22 hours a day—and use the other two hours to clean up the machines. The plants are thoroughly washed, consequently, the steam and moisture tightens motor belt drives. Condensation and moisture in the motors, plus tightened belts, make motor starting conditions a heavy burden on fuses. BUSS Super-Lag fuses have definitely minimized this problem because of the long time-lag and positive contacts of the fuses.

"Where we have installed BUSS Super-Lag Fuses we have noticed an appreciable decrease in needless shutdowns, which we credit to the time-lag of BUSS Fuses as well as to their simple design."

Some of the equipment on which there are some 365 electric motors from ¼ to 15 horsepower.

BUSS Super-Lag F

Do you have a tough fuse problem—like the one at Minnesota Valley Canning Company? You can probably solve it as easily as Mr. Herrick did—by using all BUSS Super-Lag fuses.

Buss fuses require no maintenance or periodic inspection. They don't open needlessly. If one opens, you can be sure some condition needs correction. When one opens, it requires less than 45 seconds to renew with an inexpensive link.

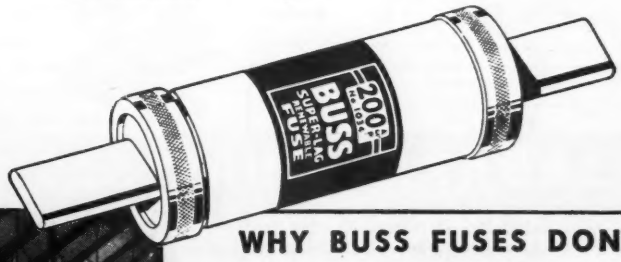
Here is why BUSS fuses greatly reduce or entirely prevent needless blows

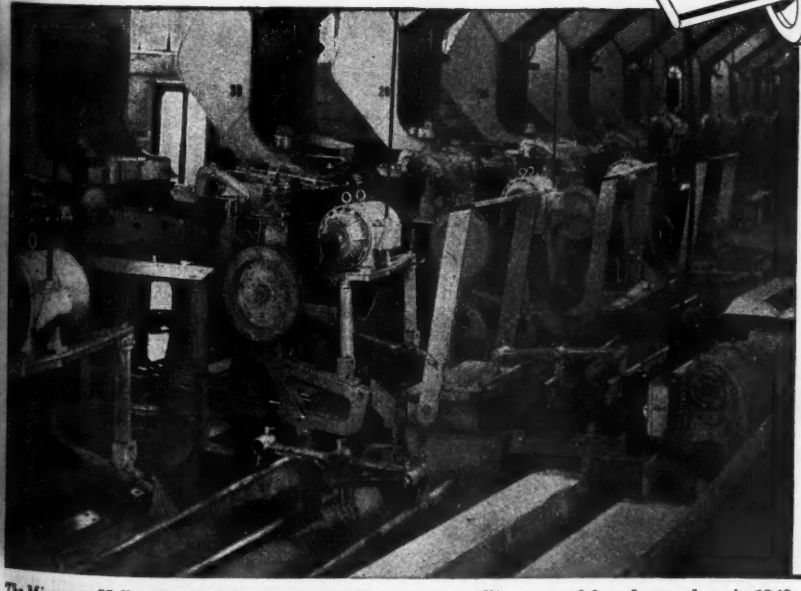
The fuse case is designed to insure good contact on the link, even when the fuse is renewed by an inexperienced person—and it is so designed that vibration or heavy overloads or the constant heating and cooling of the fuse will not permit poor contact to develop. Thus, excessive heating which causes fuses to blow needlessly is prevented.

The fuse link used is the famous "BUSS Super-Lag." It has lag-plates attached to it. These give it a long time-lag so that unusually heavy starting current or other harmless overloads will not cause the fuse to blow.

How to solve the "shutdown problem"

Pass the word along that all purchase records dealing with circuit protective devices should be immediately changed to call for BUSS Super-Lag Renewable fuses. Then, as fuses are replaced or new installations made, your plant will automatically get the benefit of the carefree, trouble-proof protection that BUSS Super-Lag fuses afford. BUSSMANN MFG. CO., University at Jefferson, St. Louis 7, Mo., *Division McGraw Electric Company.*





The Minnesota Valley Canning Co. plants turned out nearly a million cases of these fine products in 1943.

WHY BUSS FUSES DON'T BLOW NEEDLESSLY

TEN FEATURES

in the design of the FUSE-CASE help make it possible.

***and* THE SUPER-LAG**

development in the FUSE-LINK completes the job.

FUSES SOLD THROUGH WHOLESALERS

QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published, we pay $5.00.

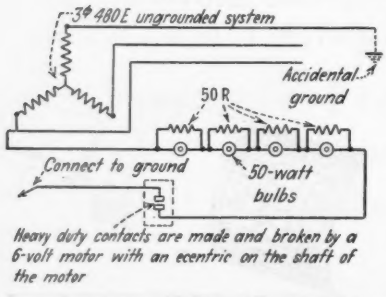
READER'S QUIZ

LOCATING GROUNDS

QUESTION 122. It would be appreciated if someone could give me an accurate method of locating accidental grounds on 480 volt, 3 phase ungrounded system, which covers an area of five square blocks, while the system is energized.

At present we induce a signal out on the system and by earphones and exploring coil we pick up the interrupted signal, but on a well loaded system with a multiplicity of sheath grounds and 60 cycle hum, it is hard to distinguish the interrupted signal especially if it is a high resistance ground.

The above is a diagram of the present testing circuit.—L. R. T.


3φ 480 E ungrounded system
Accidental ground
50 R
Connect to ground
50-watt bulbs
Heavy duty contacts are made and broken by a 6-volt motor with an eccentric on the shaft of the motor

A. TO QUESTION 122. With present equipment you evidently get a sheath current traveling from the signal generator, through conductor to the fault, and back to the signal generator, through the cable or part through cable and part through ground, on underground system.

This can be overcome, where a single cable is laid, by placing a U shaped copper conductor over the exploring coil, with the two ends of the U shaped conductor in contact with the cable.

This is called a "shunt" and amplifies the sound in the receiver up to the point of fault and will diminish in sound when the fault is passed.

Another method used, is by moving the exploring coil around the cable.

In changing the position of the coil, if the signal changes, in volume or tone, it indicates the exploring coil is still between the fault and the generator.

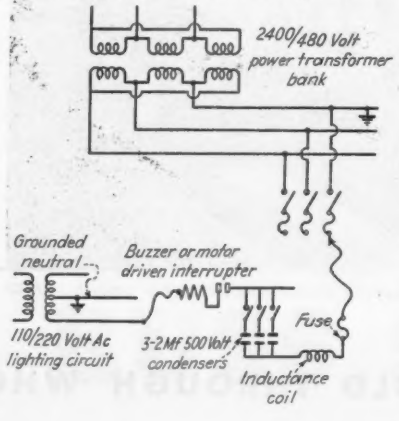
However, if signal does not change, in tone or volume, the fault has been passed.

In systems with several cables in a duct, bonded together, the same sheath current produces errors.

In this case, if signals are heard on each side of the bond, the fault is away from the signal generator and if heard only on one side of the bond, the fault is toward the generator.—R.J.P.

A. TO QUESTION 122. Your exploring coil will locate the ground accurately if you have a very distinct signal. On our 480-volt system I use a potential transformer with a telechron motor driving an interrupter with unequal spacing of cams to insert a capacitor intermittently in the circuit; this capacity spark gives a loud snap in the ear phones and can be followed along conduit, cable and open wiring to the fault.—E.J.K.

A. TO QUESTION 122. L.R.T. will find the device shown on the sketch below very satisfactory for locating accidental grounds on 480 volt systems. The grounded 480 volt line is first located with a voltmeter or Wiggmeter tester by taking voltage readings from each phase of some convenient switch to ground after which the interrupted signal is sent out over the grounded phase and picked up with an exploring coil held near the lines or cables.



The signal generator consists of an interrupter (either buzzer or motor driven) in series with three 2 mf condensers in parallel and an inductance coil and fuse. The strength of the signal can be varied by switching in more or less of the 2 mf condensers.—B.C.M.

ELECTRIC DYNAMIC BRAKING SYSTEM

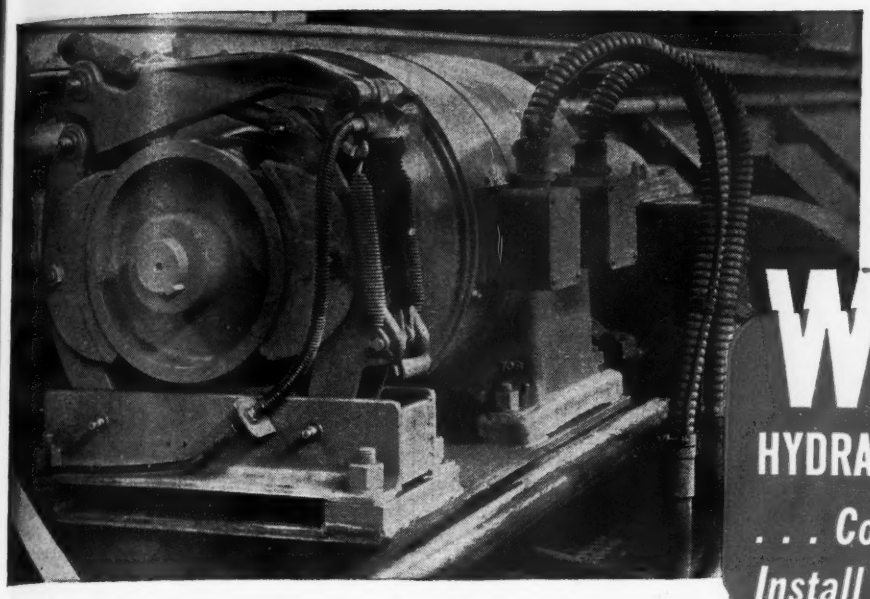
QUESTION 123. Can you tell me how I can install an electric dynamic braking system on a 200 hp., 440 volt, 3 phase motor, type MR or slip ring motor? What I want is something like what we have on a 100 hp. motor of same type and voltage. When this 100 hp. motor is energized by dynamic brake, we apply 200 amp. at 24 v. d.c. to one phase of the stator winding and the braking degree is controlled by one, two and three contactors of the secondary circuit. The rating of this 100 hp. motor is 870 r.p.m., 125 amperes, primary 440 volt, 3 phase, secondary volts 274, secondary amperes 160.

The d.c. is supplied by a 208 amp., 24 v. d.c. generator driven by a 7½ hp. motor.

I want a duplicate hook-up for a 200 hp. motor, Model 85E910G1, Type MR, volts 440, amps. 246, phase 3, cycle 60, speed 870. Secondary volts 532, secondary amps. 171.5.

I can't figure out the volts and current d.c. for the 200 hp. a.c. motor. What will it be?—C.S.M.

A. TO QUESTION 123. Maximum braking torque will occur when a d.c. current of about 250 percent of full load current is applied. Less current can be used for lower braking torque. Your present motor uses 160 percent of full load current. For the 200 hp. motor a maximum of 615 amps. could be used. For a lower torque, comparable to that of your



MODERNIZE YOUR CRANES with WAGNER HYDRAULIC BRIDGE BRAKES

. . . Complete – Ready to Install on New or Old Cranes

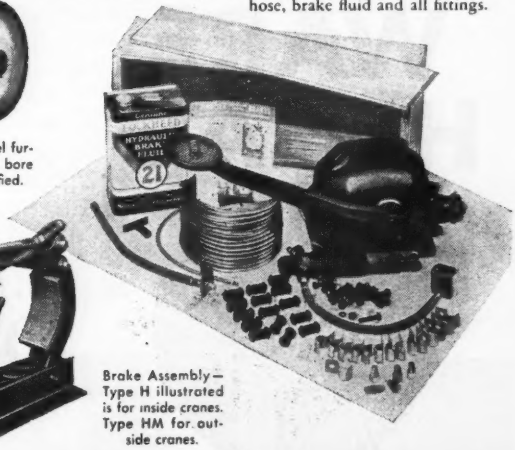
Wagner hydraulic bridge braking systems come in two types: type H for inside cranes, and type HM for outside cranes where automatic parking attachment is necessary.

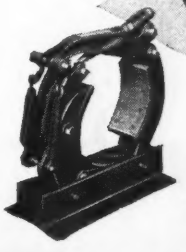
A few of the many points of excellence of Wagner hydraulic bridge braking systems are:

1. Easy one-point adjustment.
2. Exclusive anti-drag device.
3. Hardened pins, knurled to prevent rotation.
4. Bushings at all points of maximum wear.
5. Grease fittings on all hinge pins.
6. Extra-thick friction blocks are bolted to the shoes.
7. A nation-wide service organization thru 25 branches.

The complete system includes everything necessary – brake assembly, brake wheel, master cylinder, wheel cylinder, tubing, flexible hose, brake fluid and all fittings.

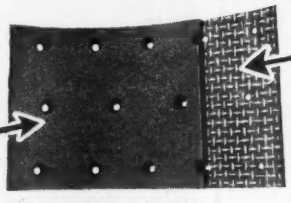
Brake Wheel furnished with bore as specified.





Brake Assembly – Type H illustrated is for inside cranes. Type HM for outside cranes.

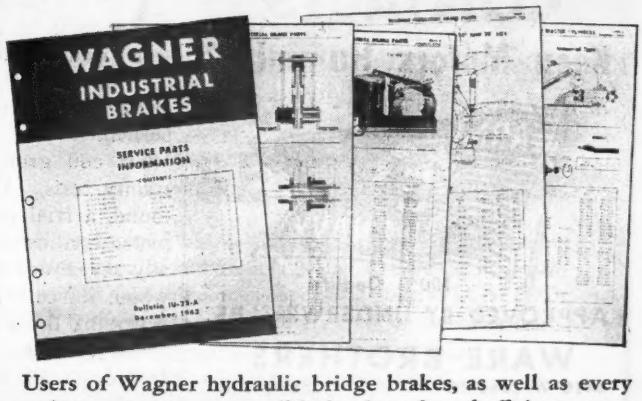
REPLACEMENT BRAKE LINING FOR ALL INDUSTRIAL BRAKES


Reinforced wire backing permits deep seating of rivets.
Non-scoring.
Preformed in blocks to fit all makes and sizes of crane brakes.

Wagner molded wire-backed blocks have the following advantages:

1. Non-abrasive – will not score brake wheels.
2. Suitable for use with any type of brake wheel.
3. Preformed to size and molded to wheel diameter.
4. Wire-backed to permit deep seating of lining bolts or rivets.
5. Molded blocks save installation time because they are easily applied.
6. Available from Wagner branch stock.
7. They reduce inventory by eliminating excessive stocks of roll-type lining which is generally purchased in long lengths in order to obtain the best price.

New PARTS MANUAL NOW AVAILABLE



Users of Wagner hydraulic bridge brakes, as well as every maintenance man responsible for the safe and efficient operation of overhead cranes, should have Service Parts Bulletin IU-22A, Service Instruction Bulletin IU-18B, and Bulletin IU-20 on Wagner Industrial Brake Equipment. Copies will be sent upon request.

ARMY E NAVY

144-3

Wagner Electric Corporation

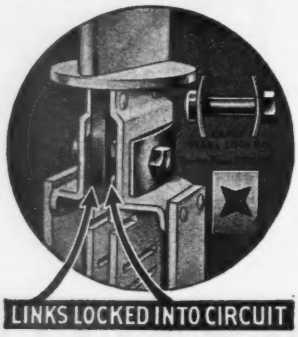
ESTABLISHED 1891

6413 Plymouth Avenue, St. Louis, Mo., U. S. A.

ELECTRICAL AND AUTOMOTIVE PRODUCTS

Greater Efficiency with COOL FUSES

WARE HI-LAG



NON-HEATING CONTACTS

Keep Motors Humming

100% Quality

APPROVED BY UNDERWRITERS

WARE BROTHERS

4410 W. Lake St. Chicago, Ill.

WARE Renewable HI-LAG FUSES

present motor 400 amps. should be satisfactory. The voltage required is computed by ohms law if the resistance of the motor is known. From your figures the resistance of your present motor is .12 ohms and that of the 200 hp. will be .06 ohms. 24 volts will be required for 400 amps., 36 volts for 600 amps.—J.S.

A. TO QUESTION 123. Use 400 amps. at 24 volts. You don't need a hook-up because the 100 hp. hook-up will work, once you use 400 amps. at 24 volts d.c.—H. S.

A. TO QUESTION 123. To obtain the same proportional degree of electric dynamic braking on the type MR, 200 hp., 900/870 r.p.m., 440 volt, 3 phase, 60 cycle, slip ring motor, Model 85E910G1 as is obtained on the 100 hp. motor, will require 400 amperes d.c. at approximately 20 volts. The direct current connections can be made to any two of the three primary leads of the motor. By thus "exciting" the primary and with resistance connected in the motor secondary circuit, electric dynamic braking will be obtained for slowing down motor.

—W. C. R.

IDENTIFYING LEADS

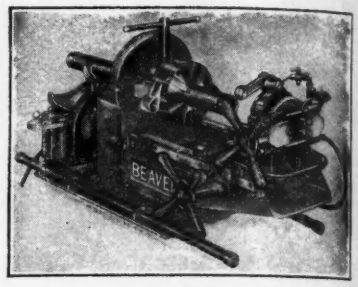
Q *UESTION 124. We occasionally run across 9 lead, 3 phase motors that have no numbers on the leads. As these motors are in difficult places I would like to know if there are ways of checking so that we can make our series or parallel connections without pulling motors apart?—H.W.*

A. TO QUESTION 124. H. W. will be able to segregate the series and parallel connections of this type of motor by the use of an ammeter. It is necessary to find the permanent star circuit and the three other coil groups by the usual continuity tests. When these have been found, a trial connection with an ammeter reading of each phase will usually reveal one or more high readings, which indicate a reversed coil group; reversing these coils usually results in lower readings until a balance is obtained on all three phases using the single circuit star or series connections. Sometimes it is necessary to rotate the inner or center star group. Once the circuit is connected in its proper sequence the usual numbering from one to nine can be applied.—L.H.

A. TO QUESTION 124. Dual voltage motors with star con-

The A-B-C of . . .

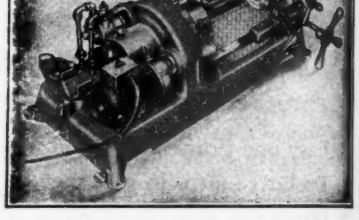
Pipe and Bolt Machines!



Beaver Model-A

A high-speed heavy-duty deluxe Pipe and Bolt Machine. Range ⅛ to 2-inch-up to 12-inch with geared tools and drive shaft. Bolts, ¼ to 2-inch. Wt. 415 lbs.

Write for Bulletin A



Beaver Model-B

A light-weight utility Pipe and Bolt Machine combining many features of Model-A with the easy portability of Model-C. Range ⅛ to 2-inch up to 8-inch with drive shaft and geared tools. Bolts up to 1½-inch. Weight 280 lbs.

Write for Bulletin B

Beaver Model-C

A STURDY LITTLE POWER UNIT Converts hand pipe tools into power tools from ¼ to 8-inch. Threads 8-inch in 6 minutes. Threads bolts up to 1½-inch. Two men can work at the same time without interference. Weight 150 lbs.

Write for Bulletin C

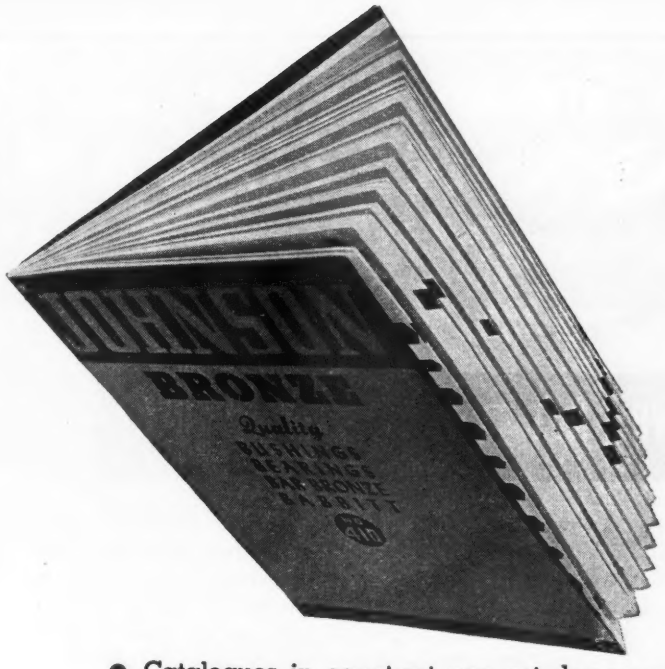
Write for new Tool and Machine Catalogue—Just off the press

BEAVER PIPE TOOLS

242 Deen Ave. Warren, O.

nections will have nine leads and four separate circuits as shown in Fig. 1. Three circuits or groups will have two leads each, and one has three leads. The circuits should be checked with a test lamp or buzzer and the three leads on a common circuit or group that form the internal star connection should have the leads tagged T-4, T-5 and T-6 in order. These tags can be permanently attached. The other six leads, should be temporarily tagged T1-T7 for one group, T2-T8 for the second and T3-T9 for the third group. It will be assumed in this case that the motor is connected for 220/440 volts; for 110/220, or for any other voltage range, all test voltages mentioned in this discussion should be changed in proportion.

After tagging the leads, attach leads T4, T5 and T6 to a 220 volt line, the other six leads being kept open. Start the motor either across the line or with reduced voltage starter. With the motor running light, no-load, the voltage across each of the three open groups should be measured with a voltmeter. The voltage should be slightly under 127 and of the same value for each circuit. With motor running, connect T4 to T7 and check the voltage across the T1-T5 leads and across the T1-T6 leads. If both these voltages are the same value and equal to about 335 volts, leads T1-T7 should be tagged permanently. If the two voltages are of the same value and about 127 volts interchange T1-T7. If voltages across T1-T5 and T1-T6 are unequal, then disconnect T7 from T4 and connect T7 to T5. Then measure the voltage across T1-T4 and T1-T6. Keep changing the leads and measuring the voltage until a grouping of leads is found where the voltages are the same and equal to approximately 355 volts as discussed above. When such groupings are found the leads should be tagged permanently as per Fig. 1. Follow the same method for each of the two remaining circuits and attach permanent tags to all leads as the correct lead is found. After all leads have been found and tagged as per Figure 1, and with motor running light, use leads T4, T5 and T6 as terminals to line. Connect leads T7, T8 and T9 together and check the voltage across T1-T2, T2-T3, T3-T1. This voltage in each case should read about 220 volts. Next shut down the motor and connect leads T1, T2 and T3 to line. Connect leads T7, T8 and T9 together. Open leads T4, T5 and T6. Make sure that T1 is connected to the same line lead as was T4, T2 as was T5, and T3 as was T6. The direction of rotation should be the same as for the previous connection. The motor can then be



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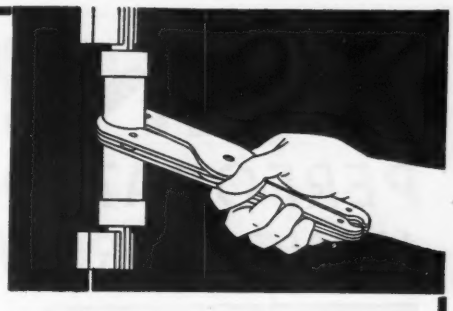

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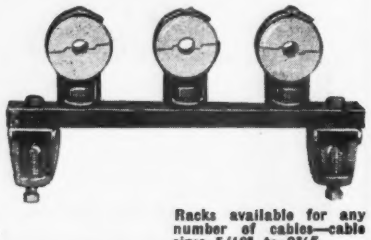

Racks available for any number of cables—cable sizes 5/16" to 2⅝".

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ELECTRIC MFG. CO.
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operated on 220 volts by connecting T7, T8 and T9 together and T1-T4 to one line lead, T2-T5 to the second and T3-T6 to the third line lead as shown in Fig. 1 forming a 2 parallel star connection. The 440 volt series star connection would be as per Fig. 1.

Dual voltage motors with delta connections have nine leads, but only three groups or circuits with three leads connected to each group, as shown in Figure 2. To find the middle or line lead such as T1, T2 and T3 of each group will require facilities for measuring resistance such as a Wheatstone Bridge or a millivolt meter and a constant value of direct current. This current rating should not exceed that of the motor. The resistance readings are comparative for sorting out the middle leg.

Series Star
T_1-T_2-T_3 to lines
T_4 to T_7, T_5 to T_8, T_6 to T_9
2 Parallel Star
T_1-T_4 to A phase line
T_2-T_5 " C " "
T_3-T_6 " B " "
T_9 T_8 T_7 together

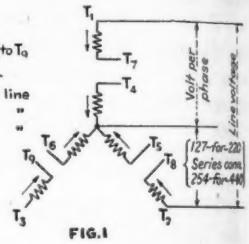

FIG. 1

Series Delta
T_1-T_2-T_3 to lines
T_4 to T_7, T_5 to T_8, T_6 to T_9
2 Parallel Delta
T_1-T_4-T_9 to A phase line
T_2-T_5-T_7 " C " "
T_3-T_6-T_8 " B " "

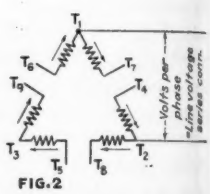

FIG. 2

Figure 2 shows that in groups T6-T1-T7, T4-T2-T8, T5-T3-T9 we must find the T1-T2-T3 leads. This can be accomplished by measuring the resistance between any two leads as the resistance across T6-T7 would be about twice that between leads T1-T6, T1-T7. Thus T1, T2 and T3 leads can be located and permanent tags attached to these leads. The remaining leads should be temporarily marked as T6-T7 in the T1 group, T4-T8 in the T2 group and T5-T9 in the T3 group in any order.

After tagging leads T1, T2, T3 connect leads T1, T4, T9 to a 220 volt line and start the motor. Make certain that all other leads are open as all parts of the windings are alive and short circuits are possible. Connect T4-T7 together and check voltage between T1-T2. If this voltage is about 440 volts the tagging is correct. If the voltage is around 380, interchange T5 and T7 or T4 and T9. Then check the voltage again. If it is about 220 volts interchange both T5 and T7, and T4 and T9. When the voltage between T1-T2 is 440, tag T4-T9-T7-T5 permanently. Make sure that leads, when connected together, produce 440 volts between T1-T2, and are marked T4-T7. This locates seven leads, T1, T2, T3,

T4, T5, T7 and T9. Next connect T6 to T9 and check voltage between T1-T3. Leave T4-T7 open and to one side. Interchange remaining leads until a 440 reading is obtained across T1-T3. Then tag T6 and check between T2-T3 with T5-T8 connected together.

When the markings are correct the voltages between T1, T2 and T3 should equal about 440 volts, after all the leads have been tested out and tagged permanently. Check the motor by shutting it down and reconnecting it with T2, T5, T7 as leads. Be certain that T7 is connected to same line that T9 was joined to, T2 to the line connected to T1, and T5 connected to the line that T4 was previously connected to. When the motor is started again, the rotation should be the same as with the first connection. If the rotation is correct, stop motor, reconnect using T5, T6, T8 as leads. Make certain that line leads are reconnected as follows. The line from T2 of second rotation check to T5, likewise from T5 to T6, and from T7 to T8. With this third connection the rotation should be the same. After this the motor can be connected as per Figure 2 for series or 2 parallel which shows the lead arrangement for low and high voltage running.—A.C.R.

TO SOLDER HEATER RESISTANCE WIRES

QUESTION 125. How may heater resistance wires that operate at temperatures above the melting point of solder (50 percent tin, 50 percent lead) be soldered? What flux, tools and solder must be used?—C.L.B.

A. TO QUESTION 125. One good method of joining resistance wires for operation at load temperature is by brazing with silver solder. Make a suitable splice for specific condition requirements. This is with reference to space limitations. Clean wires with abrasive material before splicing and apply a generous amount of borax. Apply heat with either illuminating gas and compressed air torch, presto-lite or insto-gas. When splice begins to glow apply silver sparingly and make certain that it melts and flows into crevices, forming one solid smooth molten metal joint.—O.A.

A. TO QUESTION 125. Heater resistance wires may be soldered with silver solder, using an acetylene torch with Fluron as a flux. Bicarbonate of soda may be substituted as a flux and a carbon arc type welder may be substituted for the torch. —W.A.P.

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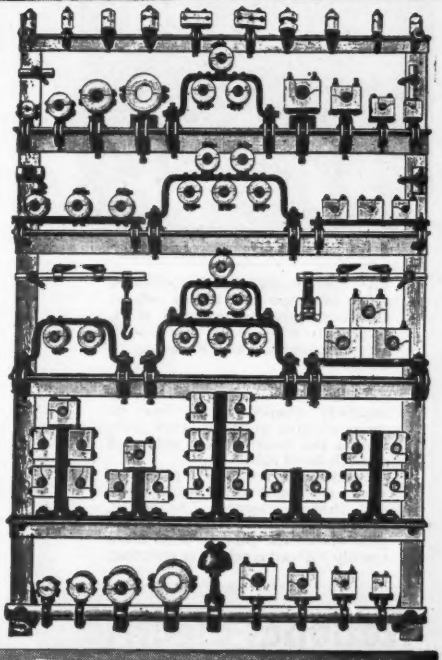

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The Spellerizing process produces a fine even grained, highly refined and homogeneous textured steel. Applied to all National pipe it may be compared to the kneading of dough.

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Spellerizing produces a pipe that works more smoothly, bends easier and threads cleaner. The softer, more even grained texture, free from pits, allows the pipe to bend more readily without cracking or splitting.

National Electric

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A. TO QUESTION 000. We had success by brazing with Sil-Fos or Easy-Flo solder. These melt at around 1100 or 1200 deg. and the heat necessary can be applied with an oxy-acetylene torch, an oxy-gas torch or even a propane (rockgas) torch. The last will only handle wires smaller than 14 gage.

We find the best method is,

First, completely scrape the oxide from the surface of the wires;

Second, pigtail leads for about ½-inch;

Third, apply a suitable flux similar to handy-flux.

The heat of the torch is applied to the top of the pigtail to avoid burning up the wire.

In cases where the temperature exceeds 1100 or 1200 deg., it would be advisable to use straight brazing. It can be done with the same method except that the necessary temperature can only be had with an oxy-acetylene torch.—S.G.B.

Can you ANSWER these QUESTIONS

QUESTION A5 I note in a diagram of an aluminum plant rectifier circuit that the cathode of the rectifier tubes and cathode breaker are in the positive lead. Any electrical dictionary will show that the cathode is always negative. Can you explain this?—R.L.D.

QUESTION B5 Is it possible to successfully operate in parallel three or more d.c. generators of different capacities, all driven by the same type of prime mover? If each is driven by different types of prime mover such as diesel and steam engines what is the maximum permissable speed regulation of each engine? Does each generator take its proportionate share of the load?—H.R.S.

QUESTION C5 I have a 60 volt d.c. compound-wound motor which I desire to convert into an arc welder. In using two six-volt storage batteries in series (12 volts) as an exciter across the fields, I find that I can melt fairly large rods. But in using a ½ hp., 125 volt d.c. motor with an output of four amps., I get only light sparks on the welding rods. In order to use this small motor as an exciter, what shall I do to the motor I'm using as a welding generator? If your answer involves rewinding of the fields, etc., give a formula for computing the number of turns, size of wire, etc. Or state any other changes that will not involve too great an expense.—D.A.

PLEASE SEND IN YOUR ANSWER BY MARCH 1

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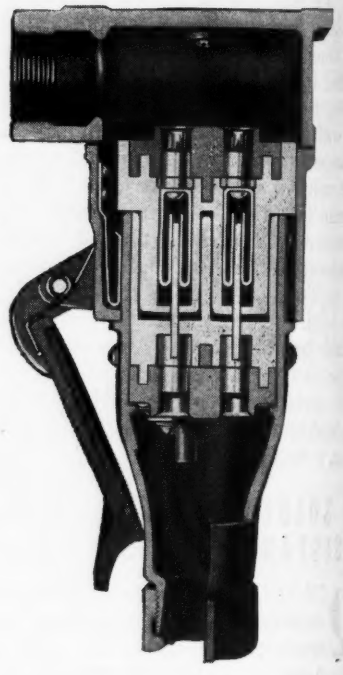
The circuit breaking plugs and receptacles . . . ratings up to 200 amperes



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Glass Rewinds Build Profits

[FROM PAGE 41]

his firm's charge for rewinding the same type of equipment today with glass insulation would be only $194.29 as against $159 with cotton insulation. Better "know how" and increased use of glass has lowered their cost and the saving is passed on to the customer.

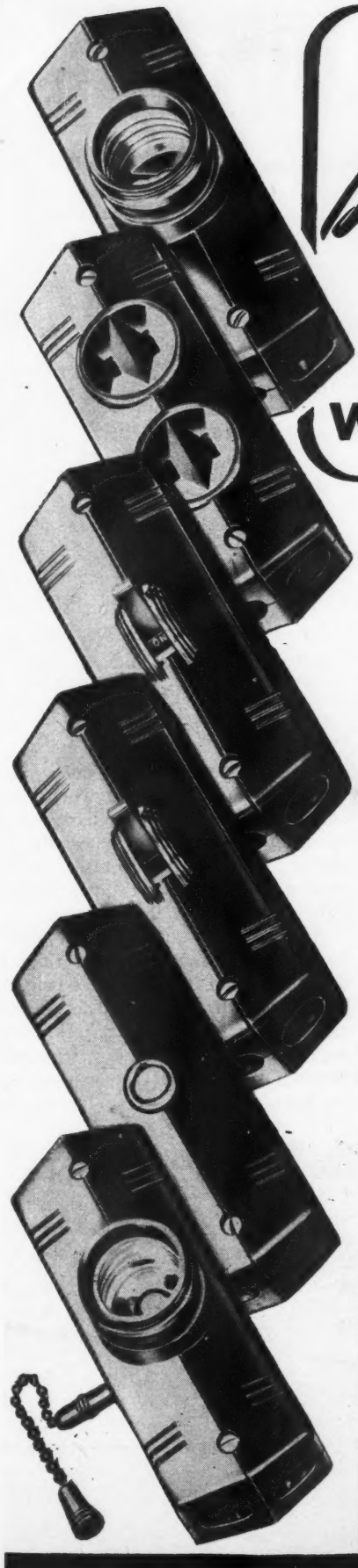
The Giles brothers insist on using the best varnishes available, for they know that the success and life of any rewind job is directly related to the quality of varnish used, the completeness of impregnation, and the correct baking cycles.

In selling rewind jobs, the actual cost of rewinding should be balanced against the value of lost production equipment hours. On this basis, Jack Giles has little trouble convincing his customers that the better job they buy, the more they get for their money. Even with spare motors or generators available, the time and expense of installing the spare, counting the value of the downtime on the equipment, is often as expensive as the rewind job itself. And both the Giles believe that this is as true of industry in general as it is of coal mining operations in particular.

Most progressive shops are making just as complete studies of their costs and probable postwar markets as are the electrical manufacturers themselves. Jack and Bill Giles have given this problem serious thought. Today the amount of work they can do is limited not by materials but by manhours. Their Armed Service Board shows eleven names. And they have lost nearly that many more again to other industries and service shops. They are employing women coil winders, insofar as they can, to make up for the labor shortage.

The Giles Armature Works feels that more glass insulation will be used after the war than is being used now in the repair field. They reason that then the emphasis of production men will shift from the desire for maximum output regardless of cost, to a careful study of production costs. Lost production equipment time will be watched much more closely. As a result the Giles feel that their customers will be even more receptive to the idea of quality work than ever before, and that the use of better quality, higher priced, materials will be much more general.

According to Jack Giles, about 75 percent of their gross volume of business is on glass insulated rewinds.



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GENERAL ELECTRIC

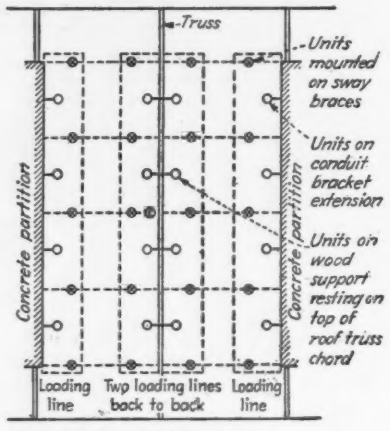
MODERN LIGHTING

LIGHTING FOR SHELL LOADING

Lighting for the shell loading lines at Oak Ordnance Plant in Illinois was designed specifically for the various tasks at hand. In some departments, intensities are higher than in others.

The original design for a bay, in which T.N.T. is poured into shells, called for an overall intensity of 10 foot-candles—considered sufficient for the task. Double glass enclosed, dust-tight, 200-watt, Holophane units were installed at a mounting height of 10 feet and suspended by conduit stems from wood sway braces on the truss chords. The fixtures were spaced on approximately 10-ft. centers, in four rows over shell loading tables. All circuits are controlled from explosion proof switches equipped with sealing fittings and mounted on the interior building wall. One fixture in the bay is on a separate emergency lighting circuit.

The specifications for the fixtures were interesting, in that they called for a perfectly smooth outer contour. This was to prevent formation of pockets of powder dust on the canopy and enclosure; and to facilitate daily cleaning of the units. Since powder dust is the acknowledged hazard in these loading lines and since conduit was extremely scarce at the time the plant was built, the engineers chose non-metallic sheathed cable for interior wiring (the dust could not permeate the outer overall covering of the cable which was dusted each day in compliance with operating regulations). Specially designed fittings incorporate rubber grommets in the hubs to make a dust-tight connection to the cables.

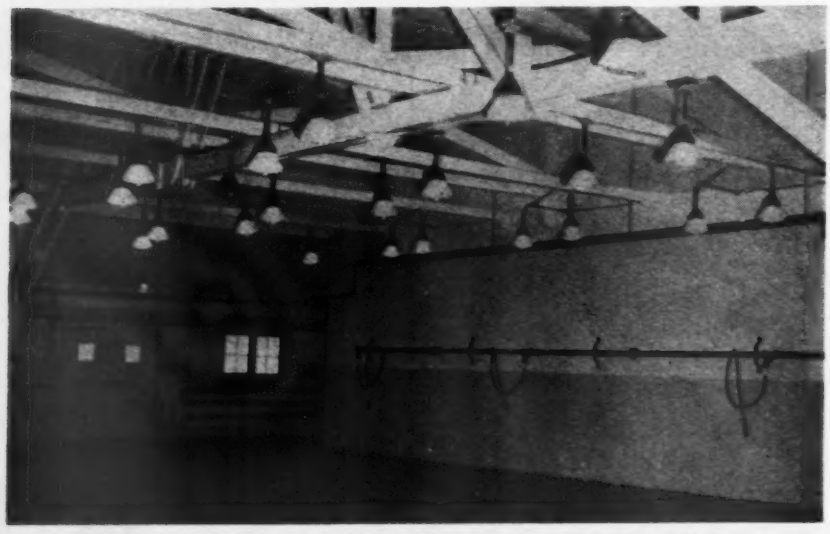


***DOUBLE ROWS** of units in a staggered pattern serve each loading lane. Units indicated by "x" comprise the original layout. Others were added to boost intensity.*

After the installation was made, however, experience in other lines in the plant indicated that the original 10 foot-candle intensity was insufficient for this particular task. The explosive is poured into the shells through funnels and the worker had to have additional light to see far enough inside the shell to stop the operation when the material was about two inches from the top of the shell.

The solution was simple—an extra row of fixtures over each loading lane. These were installed in a staggered pattern at the same mounting height (see illustration) and spotted about midway between the existing units. Those units over the lanes adjacent to the bay partitions were mounted on conduit goosenecks; those mounted over the two back-to-back middle lanes were suspended from a board cross-arm mounted to the top of the roof truss chord. The spacing was the same—midway between the existing units and in a staggered pattern. All the additional units were also fed by non-metallic sheathed cable circuits—all new runs from outdoor panels since circuit loading is carefully controlled and tapping on to existing circuits is strictly forbidden.

The overall intensity is now boosted to approximately 20 foot-candles, providing plenty of illumination directly over the loading lanes to efficiently perform the task at hand.



***SHELLS ARE LOADED** under 20 foot-candles of incandescent lighting in this ordnance plant. Fixtures are double glass enclosed with smooth outer contour to prevent powder dust collection.*

LIGHTING FOR VERTICAL SPINDLE MACHINES

This fifth article in the series on Light for War Plant Machine Tools will cover recommended lighting practices for operation of vertical spindle machines in industry. The recommendations are based on a comprehensive survey of local Chicago industrial plants made by a committee of lighting engineers. The data was compiled and presented to industrial representatives by the Chicago Lighting Institute in cooperation with the local WPB office. Ernest E. Elliott, Lighting Engineer, Sylvania Electric Products, Inc., Chicago, gave the presentation.

For the purpose of simplicity, vertical spindle machines will be roughly classified into four groups: single spindle machines, multiple spindle machines, radial drills and boring mills. There are other vertical spindle machines such as grinders, profilers, tapping machines and so on, but they are very similar to those in the above groups and it will be assumed that they are also covered in the following discussions. The first two of the above

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That's why about 40 manufacturers of famous FLEUR-O-LIER fixtures use Ballasts and Starters Certified by Electrical Testing Laboratories, Inc., of New York. These parts, like the entire FLEUR-O-LIER fixture, are tested, checked and certified by these impartial experts. They must meet definite specifications for protection of the user and for maximum light from the lamps. Certified Ballasts and Starters can be readily identified by the E. T. L. shield. Look for it when you examine the fixtures you buy or specify.

CERTIFIED E T L SPEC. No.6

You can get industrial and commercial type FLEUR-O-LIER fixtures—embodying Certified Ballasts and Starters—with the necessary WPB priorities. And all equipment meets with government restrictions in the use of critical materials.

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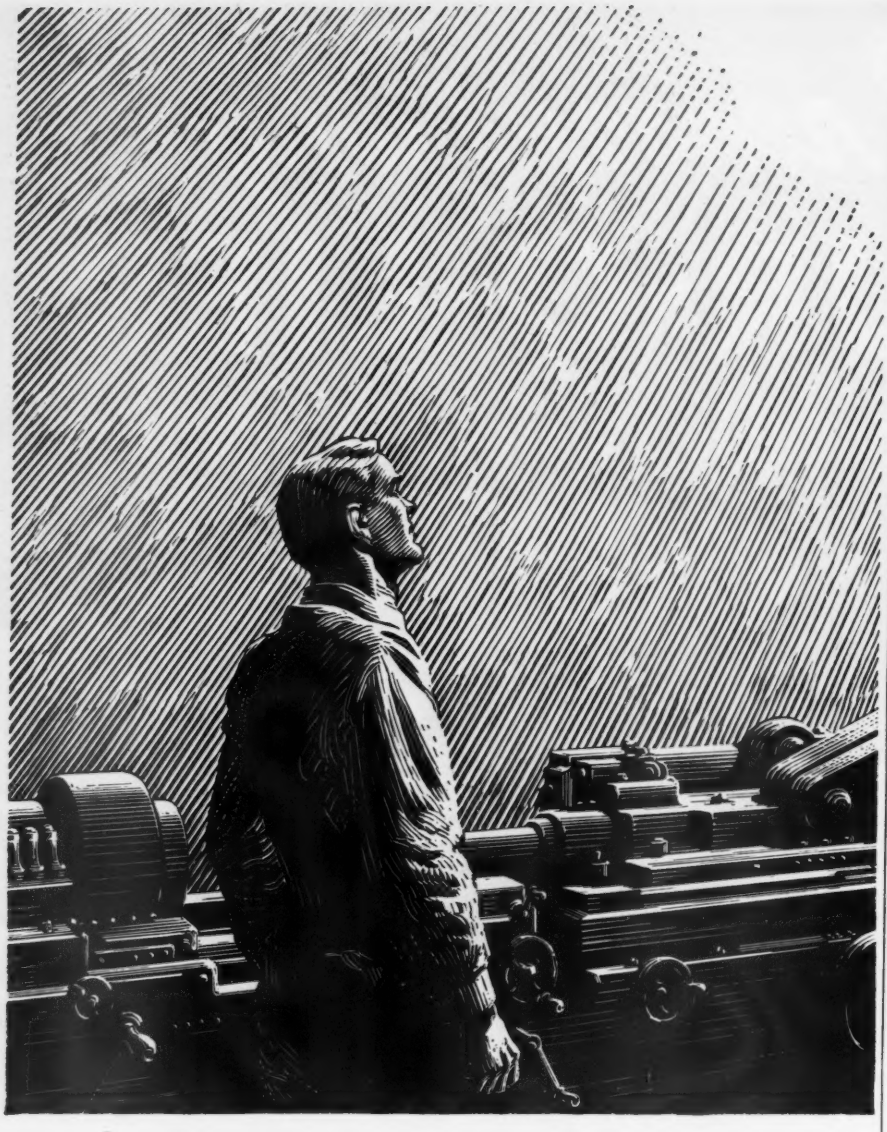
FLEUR-O-LIER

CERTIFIED FIXTURES FOR FLUORESCENT LIGHTING

Participation in the FLEUR-O-LIER MANUFACTURERS' program is open to any manufacturer who complies with FLEUR-O-LIER requirements



What's Ahead
IN INDUSTRIAL LIGHTING?

Of course, our immediate task is that of assisting essential industries to obtain all the efficiency modern illumination can bring . . . to every kind of manufacturing process. Lighting standards have so improved that production-minded men will never again be satisfied with ordinary illumination.

Today, illumination engineering is a more exact science than ever before. Tomorrow, with the lessons learned in war production, lighting will play a still greater part.

Here at Goodrich, with the same forward-looking attitude responsible for so many outstanding improvements, we are planning and working for the future of industrial illumination.

Goodrich porcelain enameled lighting equipment is sold through electrical wholesalers.

HIGHLITE

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RLM DOME

GOODRICH
ELECTRIC COMPANY
4602 BELLE PLAINE AVENUE, CHICAGO 41, ILLINOIS

mentioned group will be discussed in the following item.

Single Spindle Machines—include the most common of all, the single-spindle drills. These have been considered the easiest tool to light and many thought that ordinary overhead lighting would take care of all the requirements. Further study, however, reveals that there are many angles to even this simple machine. Manufacturers have recognized this fact and are giving serious thought to the subject. Some are even incorporating supplementary lighting in the machine itself.

The operator of a single-spindle drill must know at all times the condition of the drill point; must watch for "creep," misalignment or shifting of the work while drilling; and in some cases watch the feed dials. Proper light and cheerful surroundings are necessary for good work.

A good example of what should not be done was found in one of the cases investigated. Here a single-spindle drill had a highly polished chuck which took on additional polish through wear. Lighting consisted of a 100-watt lamp in a deep bowl reflector not more than one foot away from the chuck. The light was well concealed from the operator but the beveled shoulder of the chuck caused extreme and annoying glare to the operator. This was more pronounced at night when the contrast was more severe.

Other investigations revealed some excellent lighting arrangements.

Case 1—On a double bank of drills, 30 feet long, the machines were lighted by a general overhead system of fluorescent RLM units using 40-watt lamps and mounted 9 feet above the floor. In addition there was a continuous row of single-lamp fixtures mounted 7 feet from the floor, close to the machines and just ahead of the spindles. The average horizontal illumination was 30 foot-candles. With this type of lighting it is almost impossible for the operator or machine structure to shadow the work to any marked degree.

Case 2—On another single-spindle drill lighting installation, continuous two-lamp, 40-watt, RLM fluorescent fixtures mounted 8-ft., 6 in. above the floor, provided 20 to 35 foot-candles of illumination at the work. This is considered the better of the two systems since with single-lamp units a stroboscopic effect is likely to result. Furthermore, two-lamp fixtures produce a broad band of light whose reflections from the bright metal parts are not so objectionable as the narrow strips from single-lamp units.

Recommended Practice—for single-spindle drill operation is a general overhead lighting system to provide the following intensities:

Teletalk BANISHES THE GHOST OF EXCESS COSTS

Many electrical contractors today are showing overworked executives how the use of Teletalk Amplified Intercommunication Systems will banish the ghost of lost man-hours—the spectre of things they *might* get done if they had the time, which are loading them down with excess costs.

When you show them how the modern miracle of Teletalk makes waiting a thing of the past, you automatically build up profits for yourself.

With Teletalk every key individual in an organization can be in instant communication with every other—in three seconds—with the simple flick of a key. No more waiting for orders—for sales figures—for production data. Teletalk's perfect tone quality is the result of two decades spent in the development of high fidelity sound distribution systems.

Teletalk Amplified Intercommunication Systems may be obtained to fit the requirements of any organization—are easy to install—operate directly from the light circuit.

Investigate the easy selling features of Teletalk. You will find it a profit builder for your business. Write us for full information.

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Electronic intercommunication, paging and sound distribution systems for offices, stores, factories, buildings, institutions, homes and farms.

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Illustrated at right, Model 212 AM, with Annunciators, for use with 12 stations or less.

BUY MORE WAR BONDS

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"Where Quality is a Responsibility and Fair Dealing an Obligation"

GENERAL ELECTRIC

TO move the sun indoors . . . to bring into our homes, stores, schools, offices, and factories the kind of lighting that compares favorably with daylight . . . that has been the constant vision of General Electric lamp research scientists.

Today the goal is closer than ever before . . . perhaps closer than many of us realize. And yet, we have only just begun to explore the possibilities of new lighting techniques.

BUY AN EXTRA WAR BOND NOW!

Some of these lighting tools will be available as soon as the requirements of war production have been met; some must await the development of manufacturing facilities; others require further study in research laboratories.

The introduction of fluorescent lighting by General Electric opened the door to a new world of better lighting. Continued G-E research will open the door much wider.

Hear the General Electric radio programs: "The G-E All-Girl Orchestra" Sunday 10 p. m. EWT, NBC; "The World Today" news, every weekday 6:45 p. m. EWT, CBS.

GENERAL ELECTRIC

FLUORESCENT RESEARCH LOOKS AHEAD

THESE NEW ADDITIONS ALREADY ARE PLANNED FOR G-E's POST-WAR FLUORESCENT LAMP LINE

TO make a complete line of lamps and the best lamp for every lighting need always has been the aim of General Electric lamp research.

Numerous requests indicate that the lighting industry wants to know about new lamp developments as far in advance as possible. Looking toward the future, G-E sees the need for several new fluorescent lamps.

As soon as conditions permit, we expect to extend our line of G-E Mazda fluorescent lamps by offering the following new lamps:

STRAIGHT TUBULAR G-E MAZDA F LAMPS

LENGTH (INCLUDING SOCKETS)	APPROXIMATE BULB DIAMETER
Approximately 5½ ft.	T-4 or T-5
" 5½ ft.	T-6
" 5½ ft.	T-8
" 7½ —8 ft.	T-6

CIRCULAR G-E MAZDA F LAMPS

(*Announced December 27, 1943*)

APPROXIMATE OUTSIDE DIAMETER	MAXIMUM BULB DIAMETER	APPROXIMATE WATTS
8½"	T-10	20
12¼"	T-10	30
16 "	T-10 or T-12	40

G-E Lamp Research has been, and still is, at war. Because of wartime restrictions, no production facilities for these lamps are at present available, and therefore *no samples can be furnished.* However, as soon as it is possible to estimate when such lamps can be manufactured, we will give you further details and additional information as to transformers, ballasts, sockets, and other accessories.

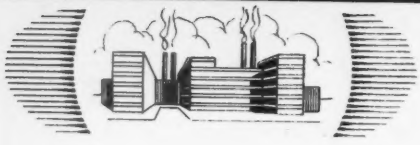
* * *

No part of your business offers a better opportunity for *immediate* post-war profits than G-E Mazda lamps. The demand for better lighting will be tremendous. General Electric will be ready to supply the lamps and help you sell them.

"TO MAKE LAMPS STAY BRIGHTER LONGER"
The Creed of G-E RESEARCH

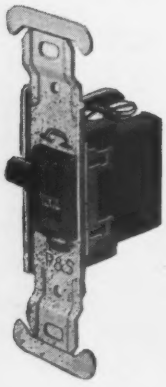
G-E MAZDA LAMPS

P&S
DESPARD
Wiring Devices
FOR
INDUSTRIAL
INSTALLATIONS



For rewiring or new work, easily assembled P&S - Despard combinations afford the greatest possible electrical efficiency in the smallest space. For replacement work, use P&S 1815-D Line switches.

Send for your copy of the P&S Catalog



PASS & SEYMOUR, Inc.
SYRACUSE 9, NEW YORK

Rough Drilling.....20 foot-candles
Medium-fine Drilling.30 foot-candles
Layout or Precision
Drilling....50 to 100 foot-candles

The types of fixtures recommended for this lighting are as follows:

For Rough or Medium Drilling—Two-lamp, 40-watt RLM fluorescent units on 10-ft. by 10-ft. spacing.

For Fine Drilling or Operations—Continuous rows of two-lamp fluorescent RLM fixtures with 6 to 10-ft. spacing between rows, depending upon the fineness of the operation.

For Long Period Close Application Drilling — Supplement the general overhead lighting with a secondary system of continuous rows of two-lamp fluorescent fixtures at a low mounting height (from 7 to 8-ft. above the floor) and located so that the axis of the fluorescent fixtures are in line with the front edge of the drill tables. The continuous rows should extend the length of the bank of drills.

Multiple Spindle Machines—project new factors into the lighting problem. The operator has to watch numerous drill points (in one case there were 108 drills) operating simultaneously on the machine. In some cases the multiple head is very close to the work and it is difficult to see the rear spindles.

Investigation revealed that one harrassing problem in such cases was the forcing out of the steel bushings of the jig plate by an accumulation of shavings. The operator was usually unaware of this until the castings were checked by the inspector and the drilling inaccuracies disclosed.

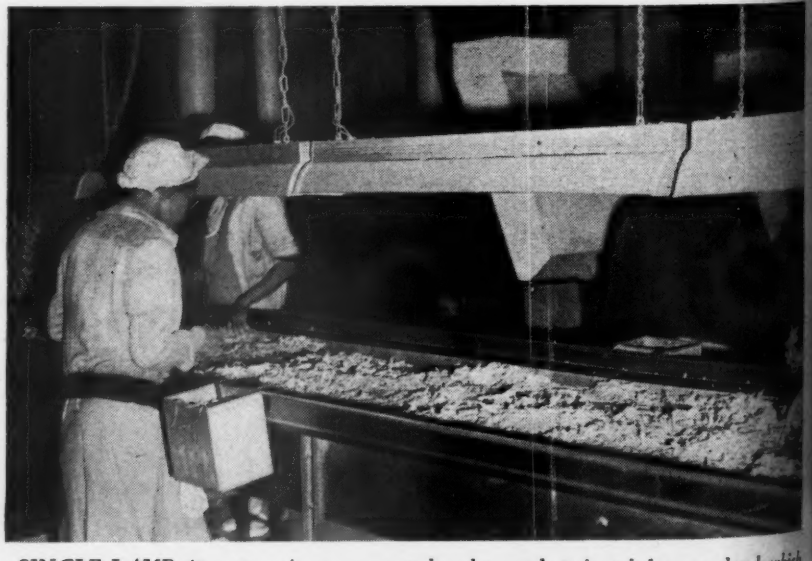
Recommended Practice—for multiple spindle machines is the installation of supplementary lighting units mounted in a fairly horizontal position. Some should be mounted at the rear and some at the front of the drill head so as to disclose what is going on at the rear drills. The work and drill points are seen due to the reflected glow from the rear lamps. If incandescent, these lamps should be equipped with diffusing covers. Otherwise, the brightness of the reflected images destroys the purpose of the lights. These local lighting units should supplement a good general lighting system of 20 foot-candle intensity.

FLUORESCENTS SIMULATE NATURAL LIGHT

Cigarette manufacture, in the preliminary stages, is mostly inspection; and inspections, being a visual task, requires both quantity and quality illumination.

Phillip Morris and Company of Richmond, Va. have done considerable experimenting in the past with various types of lighting adaptable to tobacco inspection. The result has been standardization on 40 watt daylight tubes. The units are mounted end to end over the inspection conveyors. Mounting heights vary but on the average are about 21-in. above the conveyor table. Single lamp units are used and are located just below the worker's eye-level. A maintained foot-candle level averaging 50 foot-candle is provided by this arrangement.

Several interesting aspects of their lighting problem were revealed by the history of this experimentation period. Originally, an incandescent network was used at a comparatively high foot-candle level. The glare however proved

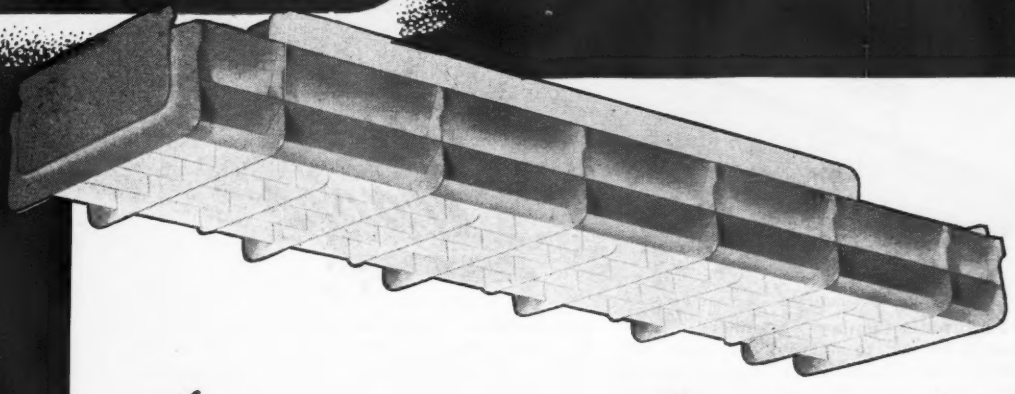


***SINGLE LAMP** 40 watt units are mounted end to end at just below eye-level which in this case is 22 inches above the conveyor table. Daylight tubes were found to more accurately emphasize the tobacco's natural colors for removal of all off-color leaf. Fifty foot-candles are provided on the table by this installation. Light is cool, plentiful and evenly distributed; eye fatigue has been reduced; and headache complaints, once prevalent under higher-mounted incandescents, have been all but eliminated.*

The New Curtis WARRIOR

FOR FOUR 40-WATT LAMPS

A FLUORESCENT UNIT *for* OFFICES AND DRAFTING ROOMS



★ Outstanding Beauty

★ Louvered for Optimum Shielding

★ Easy to Maintain

★ Meets W. P. B. Limitations

★ Backed by Curtis Reputation

Designed and Packaged FOR PRACTICABILITY

The new "Warrior" is typical of Curtis advanced designing which embodies both beauty and practicability • The basic unit is adaptable to a number of variations . . . One . . . the complete unit with louvers for either ceiling or pendant mounting • Two . . . the unit less louvers for either pendant or ceiling mounting • Three . . . the unit with or without louvers for continuous runs • The "Warrior" is packaged to simplify installation . . . hangers, louvers, wireway and other parts are packed separately and a minimum number of packages are necessary to assemble any basic unit. The same parts are used in making up continuous runs, thus eliminating overlapping stocks. Complete data and specifications await your inquiry. Why not write today?

CURTIS *Lighting*, INC.

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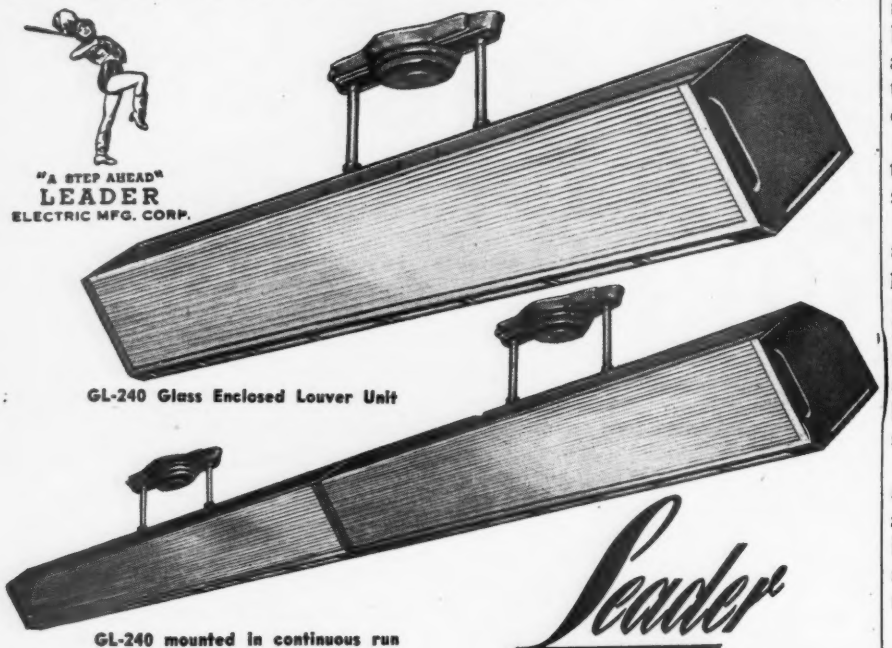
END OFFICE FATIGUE!

"A STEP AHEAD"
LEADER
ELECTRIC MFG. CORP.



GL-240 Glass Enclosed Louver Unit

GL-240 mounted in continuous run

Leader

● Improved lighting conditions have proved, by test, to materially increase efficiency. The GL-240 Glass Enclosed Louver Unit was designed and produced by LEADER to make fine lighting available for institutional and office applications. These lights are recommended for hospitals, schools, stores, etc. They are architecturally suitable for the modern trend in decoration.

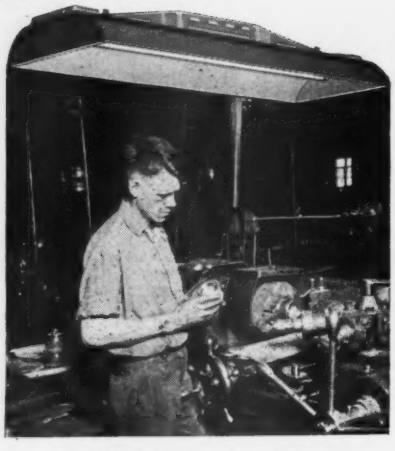
Specifications: Model No. GL-240—designed for two 49-inch 40-watt lamps. Newest approved type high power factor ballast and replaceable starters. Overall length 49". Overall width 10⅝". Height 7¼". Two 36-inch ⅜" I. P. stems furnished as standard equipment. 110-125 volts, 60 cycle, A. C. operation. Wired complete ready to install. Adapted for installation in continuous run in either ceiling or pendant mounting.

Specialized Production

ZIU-240 Closed End Industrial Unit

● LEADER engineers have designed and perfected this ZIU-240 Luminaire to meet the specifications and requirements for a fine lighting unit. It provides efficient, concentrated light to meet the needs of high speed industry and provides the answer for all complex and specialized lighting problems. The LEADER ZIU-240 offers utmost economy in initial cost and upkeep.

Specifications: Length 51". Width 13⅝" Height 7". Channel finished in gray baked enamel. Reflector finished in double coated baked white enamel reflecting surface. Top surface finished in baked gray enamel. Reflecting factor app. 89%. Electric Supply Service. Underwriters Approved. Brick. HPF type. 60 cycle, 120 volt, A. C. Other voltages available on request.



● Write for complete facts on our line and on our engineering service which is available without charge.

LEADER ELECTRIC MFG. CO.
6128 BROADWAY CHICAGO 40, ILLINOIS

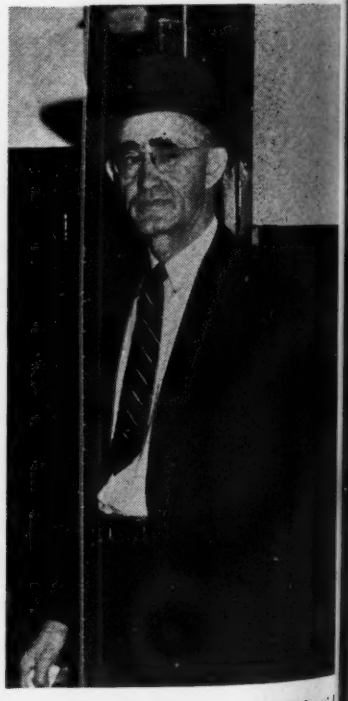
prohibitive, and in addition, headache complaints were quite prevalent among the workers. Then, when fluorescents became available, they were immediately tried at eye-level mounting, but the first group of units threw a shadow directly down the center of the table. A redesign on the reflector eliminated this and the new type of unit was installed throughout the inspection area.

White lamps were used first, but since they brought out (or rather emphasized) the greens, browns and reds, selective inspection was impossible. Daylight lamps proved to be the answer. Various combinations and other shades of white light were tried, but the daylight tubes gave the best simulation of natural light.

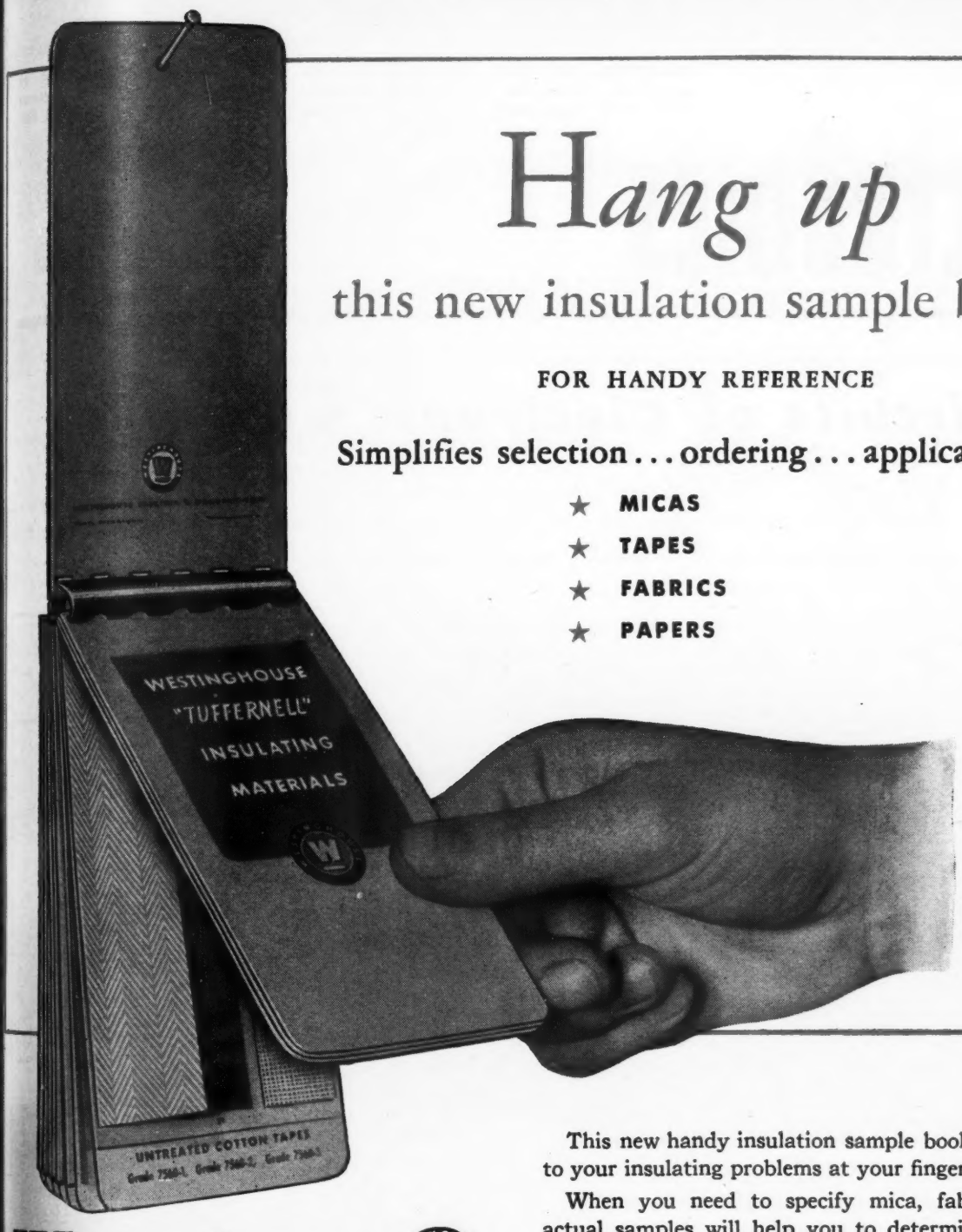
There are no windows in the plant, so the correct quantity and quality of artificial light is essential. Since the installation of their present fluorescent system, headache complaints have been reduced to almost zero.

Lighting for tobacco inspection cannot be compared with the extreme degree of criticalness of aircraft part inspection for instance, but nevertheless is quite critical with respect to production of quality cigarettes. The inspection is very tedious, for all off-color tobacco, foreign matter and stems must be removed before reaching the final processing. The only answer is, of course, plentiful illumination.

[Continued on page 139]



O. F. CARMACK, supt. of industrial construction for Richardson-Wayland Electrical Corp. of Roanoke, Va., has been supervising a summer maintenance program on commercial and domestic heating units. Several hundred contracts were obtained for cleaning, checking and putting in first class condition any type of heating unit.



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Simplifies selection . . . ordering . . . application of

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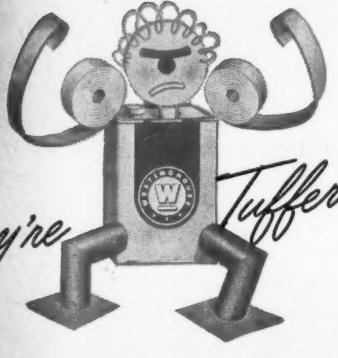
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

INSULATING MATERIALS



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This new handy insulation sample book puts answers to your insulating problems at your finger tips.

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Naturally, only representative samples of the complete Westinghouse line of Tuffernell Insulating Materials can be included in this book. Other items include sleeving, cordage and wedges; varnishes, thinners, enamels, paints and oils; cements, compounds, babbitts and solders . . . every one developed for, and "tested-in-use" in Westinghouse electrical apparatus all over the world.

Copies of this handy sample pack are available free through your nearest Westinghouse distributor. Ask for the Tuffernell Insulation Sample Guide—B-3322. Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., Dept. 7-N.

J-06355

PRACTICAL ARTICLES on the application, installation and maintenance of electronic apparatus in industry. Readers are invited to contribute items from their experience to this department. Articles used will be paid for.

ELECTRONICS

Circuits of Electronic Controls

As a background for the electronic maintenance articles to follow, fundamental circuit operations of such devices as the photoelectric relay, ignitron contactor and time-delay relay are explained in this new series.

By G. M. CHUTE

Application Engineer, General Electric Company, Detroit, Mich.

BEFORE anyone can properly maintain an industrial control he must understand its circuit and the purpose of each part. This is especially true with electronic controls, those whose circuits include tubes such as thyratrons, ignitrons, or the high-vacuum types. To explain some of these electronic-control circuits, this article will:

1. Show several simple tube circuits operating from d.c. supply.
2. Show these same circuits adapted for a.c. operation.
3. Explain in detail a commercial form of time-delay relay (a.c., tube operated).

Articles to follow will:

4. Describe an all-tube time-delay circuit.
5. Show the circuit of an ignitron contactor.
6. Explain a commercial form of photoelectric relay.
7. Show how thyratrons, with phase-shifted grid circuits, are used to control a d.c. motor operated from an a.c. supply.
8. Add a group of sensitive amplifiers to control the thyratrons.
9. Show how thyratrons, used to fire the ignitron contactor, may provide variable "heat control" of a weld.

1—*Introducing an Electronic Circuit*

To demonstrate a very simple need for using an electron tube, Fig. 1 first uses a contact S to close the circuit to a small relay whose coil is then energized by battery B. Here S happens to be a tiny contact on the pointer of a voltmeter (which is moved by changes of voltage in some external circuit not shown); it may close or open the circuit many times, but S soon becomes pitted or damaged by the current, even though that current is only 1/100 ampere. To improve this condition, Fig. 3 adds a tube, T, between contact S and the relay coil. When S is closed, tube T passes the current (1/100 ampere or 10 milliamperes) which energizes or "picks up" the relay; however, only about 1/100,000 ampere is now flowing through contact S—such a small current that it does not pit or damage the contact. When S is open, tube T passes no current, so the relay is de-energized or "drops out". To use tube T in this way, let us see what circuit changes are required.

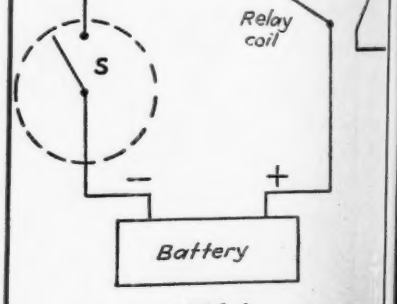


FIG. 1

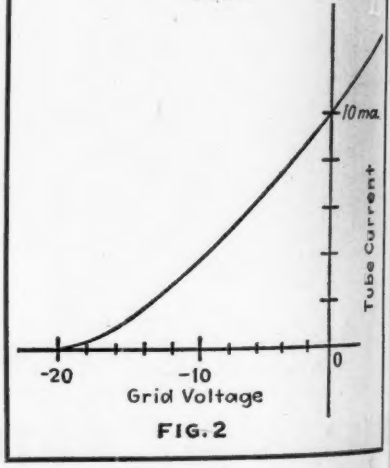


FIG. 2

A NEW DEPARTMENT

The tremendous acceleration in the technology of electronics under the pressure of global war opens new horizons of better living. Revolutionary changes are promised in entertainment, communication, navigation, and a host of other fields. It was inevitable that the versatile electron tube should find a substantial place in the ranks of industrial apparatus doing plain hard work. And today we have electronic rectifiers, electronic welders and motor control, electronic counters and sorters, electronic relays and instruments.

The interest of our readers in electronics has paralleled the rapid growth of the industry. This new department is started with this issue to provide a regular forum for articles of special interest to the electrical man who must keep up with the practical problems of electronics in industry.

We shall welcome practical questions on electronics. Those accepted will be answered in this department by competent experts.

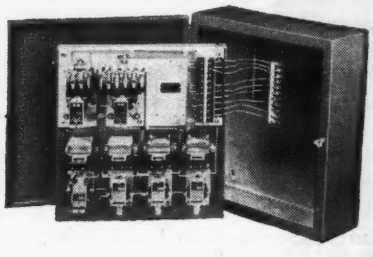
Contractors, Please Note—

YOUR INDUSTRIAL CUSTOMERS CAN GET MORE PRODUCTION WITH LESS OPERATOR SKILL *when resistance welders*

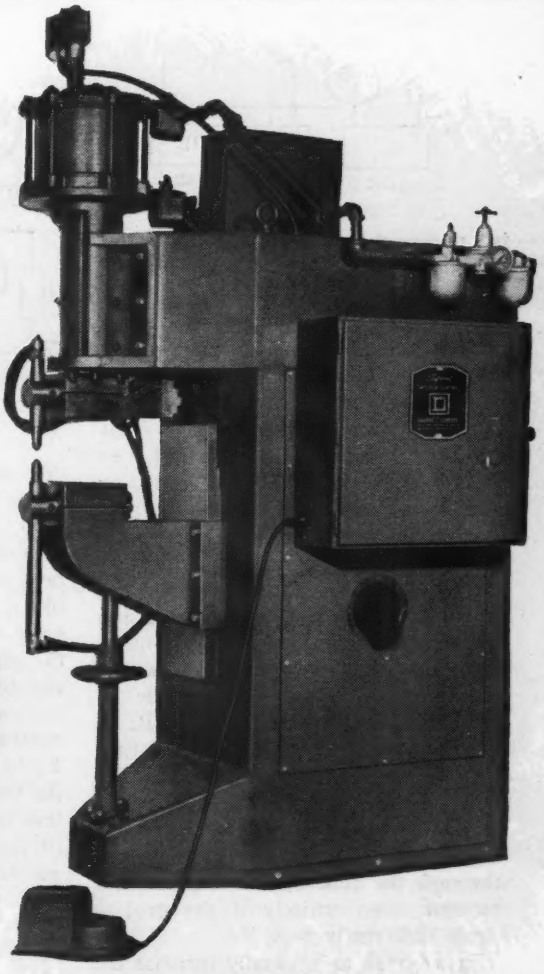
have **SQUARE D** *Automatic* **CONTROL**

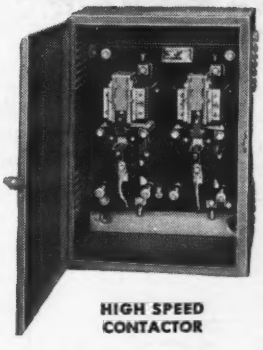
• Consistently good resistance welding at high production rates requires automatic control of pressure and current in an accurately regulated sequence. Square D welder control meets those requirements—exactly. It is simply designed, easy to install and maintain. With Square D automatic control on the job, very little operator skill is required—a vital angle during today's scarcity of skilled manpower.

Specify Safront timers and Syncro-Break or High Speed contactors on new welding machines. Or, if increased quality and production is needed from present machines, find out how easily they can be equipped with automatic control. Consult your nearest Square D Field Engineer.

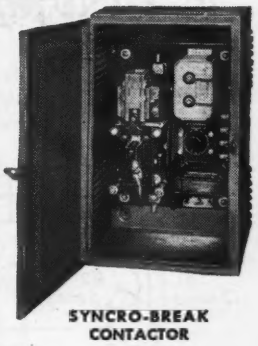


SAFRONT TIMERS (above) are built in 18 NEMA standard types. Notice, in upper left photo, how all electrically energized parts are behind a protective panel, yet calibrated timer adjustments are accessible on panel front. Separate timing devices, provided for each step of the welding cycle, are individually adjustable from 3 to 100 cycles. Safront interiors "swing out" (upper right photo) to expose operating parts.





HIGH SPEED CONTACTOR



SYNCRO-BREAK CONTACTOR

HIGH SPEED AND SYNCRO-BREAK CONTACTORS (right) possess unusual design features necessary for frequent making and breaking of the welding transformer primary circuit. The Syncro-Break design includes means for opening circuit without arcing at contact tips, thus increasing contact life and allowable ratings.

ELECTRICAL EQUIPMENT • KOLLSMAN AIRCRAFT INSTRUMENTS

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Basic Circuit Requirements

In Fig. 3, we use battery A to heat the filament of tube T, and we use battery C so that its negative terminal is connected (through R1) to the grid of T. When S is open, the voltage of battery C serves to keep the grid

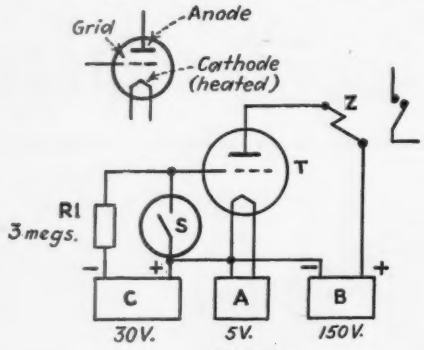


FIG.3

so much more negative than the cathode (−30 volts) that tube T is unable to pass current. (Fig. 2 shows that this kind of tube passes no anode current when its grid is more negative than −20 volts). However, when S is closed, the C-battery voltage appears only across R1; the grid is at the same potential as the cathode, (or we say the grid voltage is zero), so tube T passes current.

In a quick review, let us see what makes this electron tube operate. (1) Current passes through tube T, through the space between anode and cathode, requiring no metal-to-metal contact. (2) This current can pass in one direction only, from anode to cathode; (if we reverse battery B, no current will ever flow through tube T). (3) Heat is required at the filament, before this kind of tube can work. (4) As the grid is made more negative than the cathode, the current through the tube decreases; the tube current stops entirely if the grid is made sufficiently negative.

If we wish to gradually increase the current passing through tube T, we use a variable resistance R2 or rheostat in place of contact S, leaving the rest of the circuit unchanged, as shown in Fig. 4. With R2 turned counter-clock-

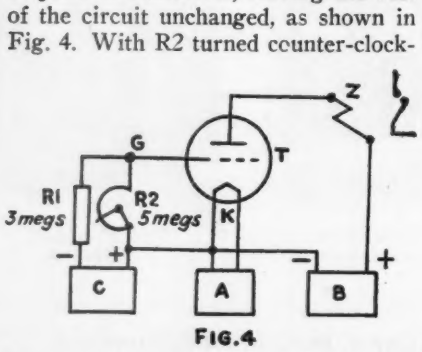


FIG.4

wise so all its resistance is in circuit, most of the C-battery voltage appears across R2, so the potential of grid G is about −20 volts (20 volts more negative than cathode K) and tube T passes no current. If we now turn R2 clockwise slowly, the potential at grid G gradually becomes less negative, or rises closer to the potential of cathode K; this permits more current to flow (anode-to-cathode) through tube T, until this current becomes great enough to pick up the relay.

A Light-Sensitive Relay

To obtain a photoelectric ("electric eye") relay, we merely substitute a phototube P in place of R2, as shown in Fig. 5. This phototube is an electron

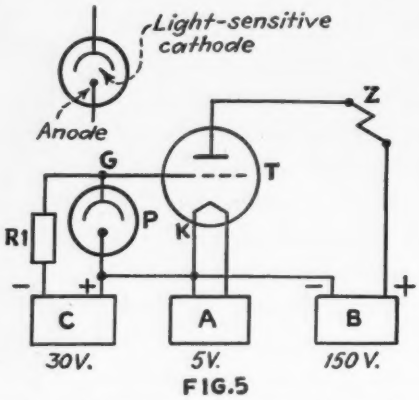


FIG.5

tube which passes current (from its anode to its half-cylinder-shaped cathode) whenever light shines on its cathode. With no light, the dark phototube passes almost no current and acts like a very high resistance. By gradually increasing the amount of light, the phototube passes more and more current, and decreases its amount of resistance. In this way, phototube P controls tube T (in the same way as R2 in Fig. 4); more light shining on the phototube causes grid G to become less negative, and this causes tube T to pass more current. Note that the phototube itself passes such a tiny current (perhaps five microamperes or 0.000005 ampere) that it cannot pick up the relay Z directly; however, this phototube current can control the grid potential G so that tube T passes the larger current necessary to pick up relay Z.

Returning to Fig. 3, if we now wish to cause tube T to pick up relay Z when we open contact S, we merely interchange R1 and S, as shown in Fig. 6.

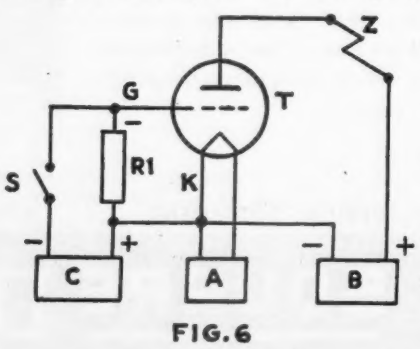


FIG.6

With S closed, the voltage of battery C appears across R1, so the grid G is 30 volts more negative than cathode K; tube T passes no current. At the instant when S is opened, the C-battery is disconnected from R1; the voltage across R1 instantly disappears and brings grid G to the same potential as cathode K; tube T instantly passes current and picks up relay Z.

A Time-Delay Relay

Suppose we wish to pick up relay Z a short time after S is opened, or make the circuit operate as a time-delay relay. This is done merely by adding a capacitor C1 across resistor R1, as shown in Fig. 7. Here, when S is closed, the C-battery voltage appears across R1 as before, and tube T passes no current. However, notice that C1 is also charged by this same 30 volts of battery C and stores some electric energy within itself. At the instant

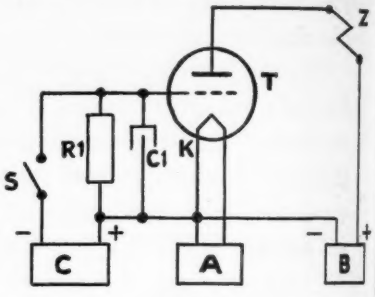
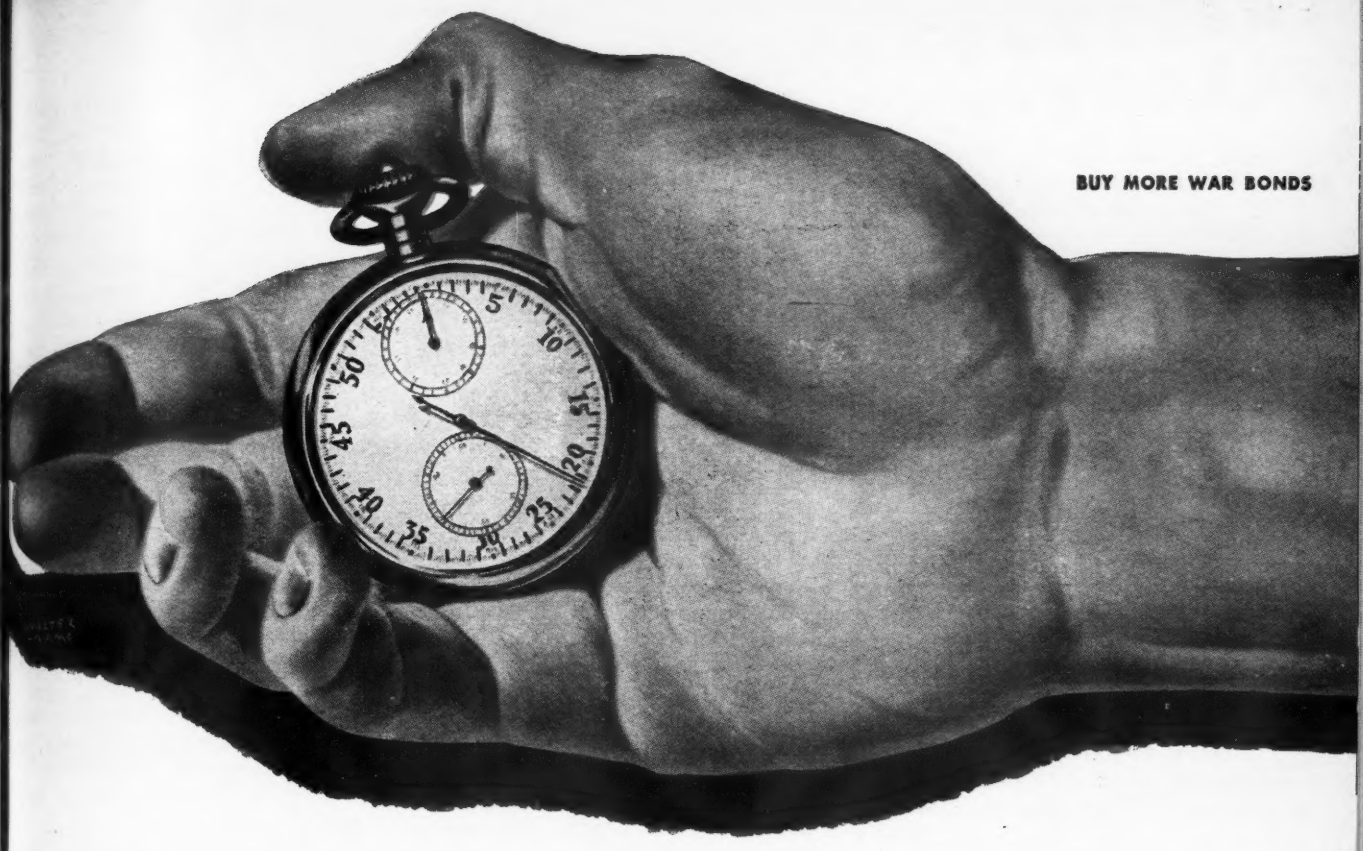


FIG.7

S is opened, the C-battery voltage is disconnected as before, but the voltage across R1 cannot instantly disappear, for capacitor C1 still holds some of its energy; for a short time C1 acts like a tiny battery and forces current to flow through R1, so that there still is a voltage across R1 which keeps the grid G negative. After a short time delay, C1 will have lost enough of its charge so that the voltage across R becomes small enough to permit tube T to pass current and pick up relay Z. The amount or length of this time delay depends on the amount of resistance (megohms) in R1, as well as the amount of capacity (microfarads) in C1. By increasing either the megohms or the microfarads, we increase the time delay.

2—*Substitution of A. C. Power Supply*

Pause a moment to realize that the circuits of Figs. 3, 4, 5, 6 and 7 are exactly alike except for changes in the grid circuit of tube T. Yet by these changes we obtain first a "contact-amplifier", then a photo-relay, and finally a time-delay relay. Of course, all of these circuits operate from d.c. power supplied by batteries. In next showing how to use a.c. instead of d.c. supply, we will see that the same



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method is used for any one of these circuits.

If we substitute a.c. supply to the photo-relay of Fig. 5, the result in Fig. 8 shows that we have used a transformer, whose three secondary windings, A, B and C, have replaced

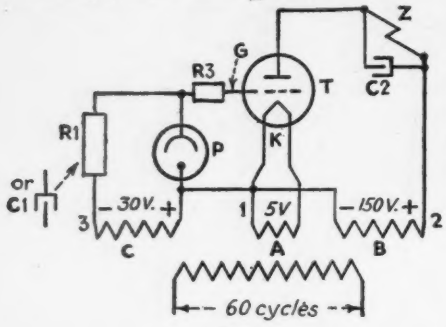

FIG.8

the three batteries. The 5 volts (rms) of winding A heats the filament just as effectively as the 5-volt A-battery. However, although winding B furnishes a complete a.c. wave of voltage (so that point 2 is alternately more positive and more negative than point 1, as shown in Fig. 9), winding B can force current through relay Z

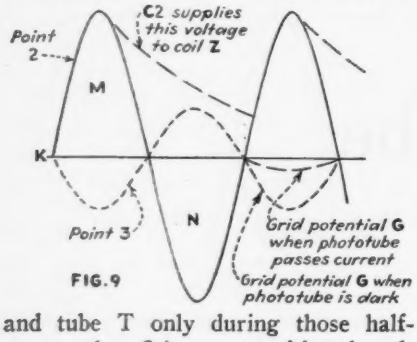

FIG.9

and tube T only during those half-waves when 2 is more positive than 1. (During the other half-waves N, shown in Fig. 9, the rectifying action of tube T prevents current flow. Since relay Z is now energized by only half-waves of the a.c. supply, it tends to chatter unless some device is added to the circuit to help, such as by adding C2 in Fig. 8. Capacitor C2 charges to the voltage across relay coil Z while T is passing current, then C2 discharges during the next half-cycle, maintaining partial voltage across Z, as shown in Fig. 9.

An A.C. Photoelectric Relay

As shown by the above example, whenever a tube is used in an a.c. circuit, we must check to see what happens during each half-wave separately. So, in studying the grid circuit of tube T (supplied by transformer winding C in Fig. 8), let us first consider that half-wave when windings B and C have the polarity shown (which is also the half-cycle marked M in Fig. 9). If phototube P is dark and passes no current, there is no current flowing through R1, and grid G is at the same potential as point 3; since point 3 is much more negative than K (cathode), tube T passes no current, even though its anode is positive during this half-cycle. However, if enough light shines on phototube P, it passes current through R1, so that most of the voltage of winding C now appears across R1. The grid G (forgetting R3) is brought so near to the same potential as cathode K, that tube T now passes current during this half-cycle M, and picks up relay Z.

The Use of Grid Current in A.C. Circuits

Is there any current flowing through R3 and the grid of tube T, in Fig. 8? During half-cycle M (Fig. 9) the grid G is always more negative than cathode K, so no current passes from grid to cathode or through R3. However, during half-cycle N the voltage of winding C forces a tiny current to flow from point 3, through R1, R3, and from grid to cathode of tube T, to point 1. (R3 is a protective resistor, to limit the amount of grid current to a safe value.) No current can pass downward through phototube P, for this tube also acts as a rectifier and refuses to pass current cathode-to-anode even when illuminated. Notice that grid current can flow (from grid to cathode of tube T) during half-cycle N but cannot flow during half-cycle M, for current never can flow from cathode to grid. Many a.c. circuits make use of this feature, which is called "grid rectification." In the photo-relay of Fig. 8, a capacitor C1 is often used in place of R1, and becomes charged by the flow of grid current during half-cycle N. Its charge holds the grid G very negative during M; however, if phototube P is illuminated, it passes enough current during M to discharge C1 and bring the potential of grid G close to K, letting tube T pick up relay Z.

3—*An A.C. Time-Delay Relay*

To convert the time-delay relay of Fig. 7 for a.c. operation, as shown in Fig. 10, the transformer replaces the batteries, and C2 is added as before; the connection to R1 and C1 is moved, and R2 is added. With switch S closed, during half-cycle M the voltage of winding C forces current to flow only through R2 and switch S to point 3; during half-cycle N the current flows through R2 in the opposite direction. Also, current now flows from 3 through S, R1 and through tube T (grid to cathode) to point 1. Most of the voltage of winding C appears across R1, and charges C1 to this same voltage. During the next half-cycle, when "grid rectification" prevents current flow through R1 in the reverse direction, C1 loses a very small part of its charge by forcing current to flow through R1 (from 4 toward G). So as long as S is closed, the voltage across R1 alone keeps grid G so negative that tube T passes no current.

In Fig. 10, when S is opened, current through R2 stops instantly, and point 4 is at the same potential as cathode K. Voltage still remains across R1 while C1 gradually discharges through R1; this R1 voltage keeps grid G more negative than K. After the desired time delay (determined by the size of R1 and C1), the voltage across R1 has become so small that grid G is near the same potential as cathode K, and tube T passes enough current to pick up relay Z. If S is reclosed, relay Z drops out instantly. (If C2 is large enough, its stored energy may be sufficient to keep relay Z energized for many cycles after tube T stops passing current.)

If R1 and C1 of Fig. 10 are made small enough, the voltage across R1

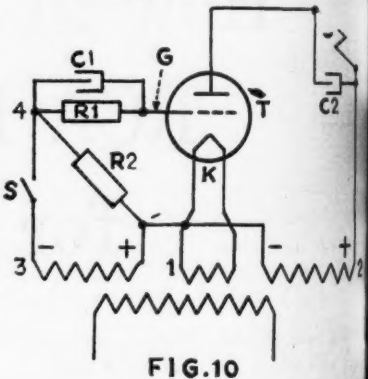

FIG.10

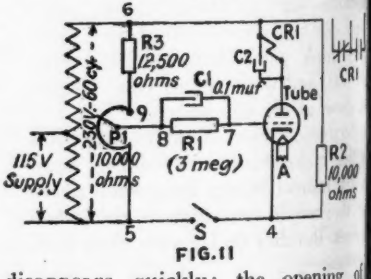

FIG.11

disappears quickly; the opening of switch S causes almost instantaneous pick-up of relay Z. The circuit of Fig. 10 is thus changed from a time-delay relay into a contact amplifier— the a.c. equivalent of Fig. 6.

Fig. 11 shows the circuit of a time-delay relay which is manufactured for general-purpose use in industry; it includes a provision (by turning P1) for selecting the length of time delay. The circuit starts its time-delay action at the instant switch S is closed; at the end of the desired time delay, tube 1 picks up relay CR1 whose contacts may be connected to close some other

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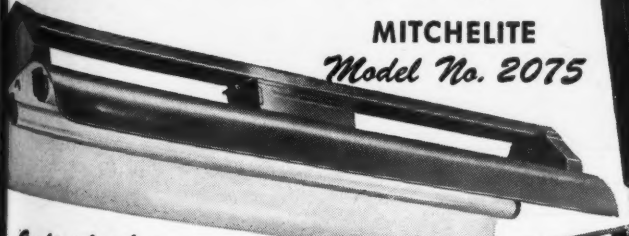

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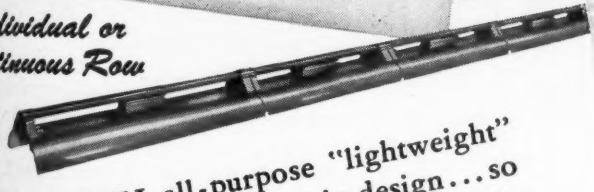

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circuit, or to open that circuit if preferred.

In Fig. 11, the power supply is 115 volts, 60 cycles, a.c., and the autotransformer (at left) increases this to 230 volts for use in the circuit of tube 1. A separate transformer winding A supplies the low voltage for heating the filament of tube 1. Notice here that tube 1 has a separate cathode (connected to point 4) which is indirectly heated; there is no electrical connection between the filament and the cathode; the red-hot filament heats the cathode so that the current flows through tube 1 from its anode to the heated cathode.

The current which picks up or energizes relay CR1 must flow from point 6, through CR1 and tube 1 to point 4, and through switch S to point 5. Therefore, the closing of S makes it possible for tube 1 to pass current, but not until the grid of tube 1 reaches a potential which permits this current to flow; we will see that the grid potential of tube 1 prevents the flow of this current until the end of the desired time delay. Reopening S drops out CR1 and resets the circuit for the next time-delay operation.

Even while S is open, the grid circuit of tube 1 is in action. During those half-cycles when point 6 is more positive than point 5, current can flow only through R3 and P1; no current flows through tube 1. However, during each half-cycle when 5 is more positive than 6 (and S is still open), current flows from 5 to the slider of P1, through R1, from grid to cathode of tube 1, to 4, through R2 to 6.

Circuit Performance During a Long Time Delay

First turn P1 so its slider touches at point 5; the entire voltage between 5 and 6 (230 volts) now forces current through the R1-grid-cathode-R2 circuit. Since the 3-megohm resistance of R1 is so much greater than any other resistance in this circuit, as much as 200 volts appears across R1, and C1 becomes charged by this voltage. Here 200 volts is the effective (or rms) value of this a.c. voltage wave, but capacitor C1 charges to the crest value ($\sqrt{2} \times 200$) or about 280 volts. During the next half-cycle, the grid-rectification of tube 1 prevents any reverse flow of current; C1 loses only a very small part of its voltage by discharging through R1. So, as long as switch S remains open, about 280 volts is steadily maintained across R1, so that the point-7 end of R2 is 280 volts more negative than the point-8 end.

At the instant switch S closes, connecting cathode 4 to point 5, the charge on C1 is holding the tube-1 grid at a potential 280 volts more negative than the cathode. However, C1 now continues to discharge through R1, so the grid potential becomes less negative, or rises as shown in Fig. 12. After about one second delay (which is the longest time delay for which this certain relay may be set) the grid potential becomes so close to the cathode potential that tube 1 begins to pass current, which quickly increases to the amount required for the pick-up of relay CR1.

Now turn P1 so its slider touches at point 9; only the voltage between 9 and 6 (about 130 volts) now forces current through the R1-grid-cathode-R2 circuit. About 115 volts is applied across R1, and C1 charges to the crest value ($\sqrt{2} \times 115$) or about 160 volts, as shown at H in Fig. 13. So point 7 is being kept 160 volts more negative than point 8.

When switch S closes, the grid of tube 1 is held negative by the charge of C1 as before; in addition, the a.c. voltage across potentiometer P1 also influences the grid potential. As shown in Fig. 13, the alternating voltage across P1 subtracts from the direct voltage across C1, so that the grid potential is raised to within 20 volts of the cathode potential. After a time delay of only four cycles, or 1/15 second, the decrease of C1 voltage has raised the grid potential so close to the cathode that tube 1 passes current and picks up relay CR1.

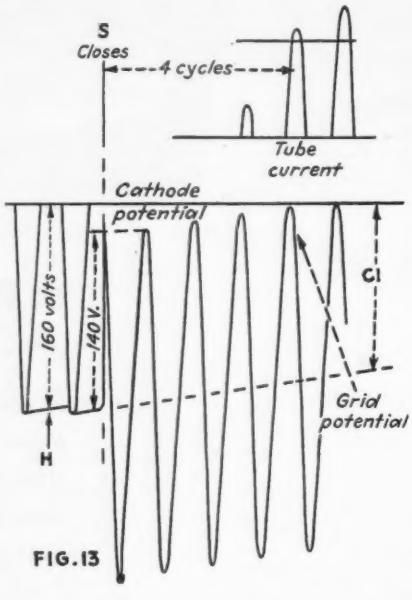

FIG. 13

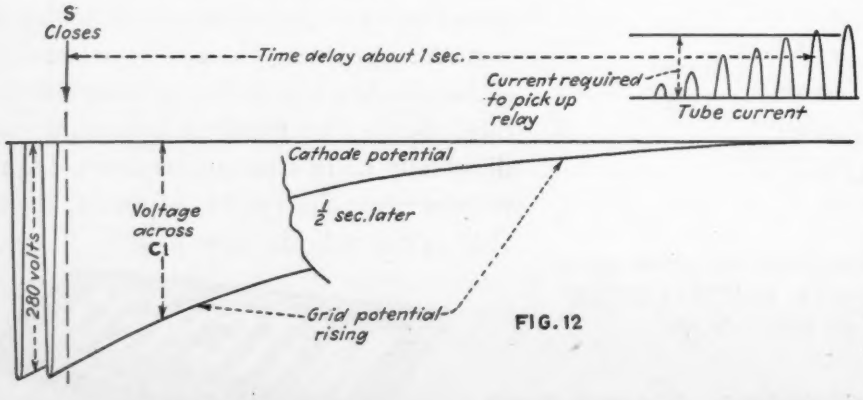

FIG. 12

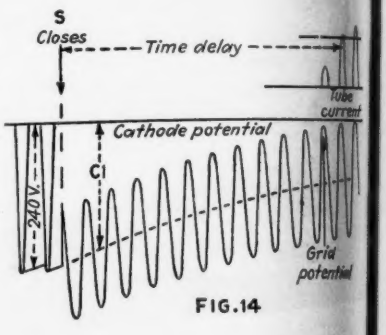

FIG. 14

Obviously, if P1 is set at a middle position, the resulting time delay will be about halfway between the longest value (Fig. 12) and the shortest value (Fig. 13). Fig. 14 illustrates such a condition.

The Thyratron Tube For Greater Current

All the circuits so far described use a high-vacuum tube whose cathode is heated; the current flowing through such a tube is usually only a small fraction of an ampere. When a greater current is needed, to pick up a larger contactor instead of relay Z, a thyratron tube may be substituted in a circuit which uses a.c. supply, such as Fig. 8 or Fig. 11. The thyratron uses a heated cathode, and has an anode and grid much like the high-vacuum tube. However, instead of a high vacuum inside its enclosure, the thyratron has a vapor of mercury or a gas; the anode-to-cathode current through such a tube may be as much as a hundred times greater than the current of a similar high-vacuum tube. The symbol for such a vapor-filled tube includes a dot.

Such a thyratron is sometimes used in the time-delay circuit of Fig. 11, and the coil of CR1 is then designed to pick up at a greater current, such as one-tenth ampere.

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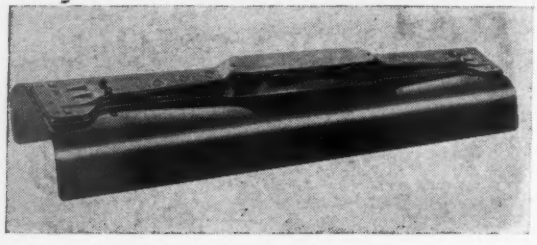
EQUIPMENT NEWS

Fluorescent Fixture

This new model HF-235R industrial fluorescent lighting unit uses two 100-watt lamps and is of the same basic streamlined design as the recent 40-watt lamp models. Suitable for individual or continuous-row mounting, it may be suspended by direct chain suspension, direct conduit mounting, messenger cable-clamp assembly, or surface mounting with bolt or lag screw. The top housing encloses the ballast for protection, and hanging flexibility is assured through one-half inch knockouts located on 24-, 30-, 36- and 47¾-in. centers. Chain-hanging brackets are also built into the top housing. Sylvania Electric Products Inc., Salem, Mass.



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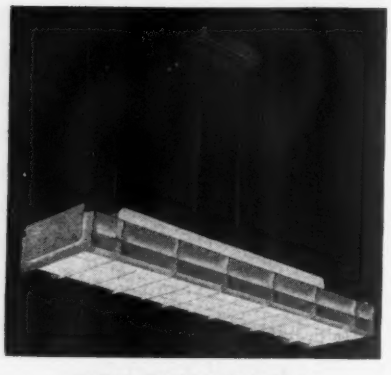
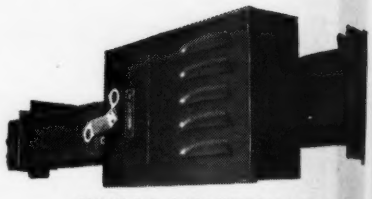


CURTIS FLUORESCENT UNIT

Capacitor Plugs

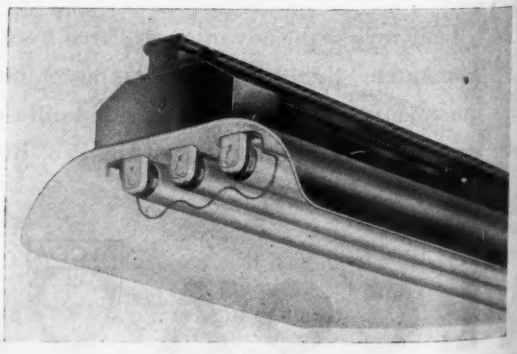
These new flexible capacitor plugs can be inserted into any convenient plug-in opening along a bus duct run. They can be mounted at the centers of the greatest load areas or can be moved about as the load areas change. Capacitor plugs are an integral unit consisting of 60 ampere 3 pole fusible switches, or 15 to 50 ampere circuit breakers connected ahead of 3 pole single unit capacitors having discharge resistors. They are made for 230 or 460 volt 60 cycle service in capacitor ratings of 1 to 15 kva. To facilitate pull-chain operation from the floor, the plugs have operating mechanisms of special design placed on hinged covers over the protective devices. Louvered screw-on covers are provided over the capacitor units. Bull Dog Electric Products Co., 7610 Jos. Campau Ave., Detroit, Mich.



BULLDOG CAPACITOR PLUGS

Lamp Safety Guards

These lamp retaining safety guards are for two 40, three 40, and two 100 watt fluorescent fixtures. They prevent lamps that are accidentally left in or jarred into an unlocked position from falling. Each lamp is completely cradled and restrained so it cannot shift downward enough to clear lampholders (sockets) and, therefore, axial movement is impossible. Each guard is provided with clips made to slide over the material thickness of the average non-metallic reflector. When used on steel reflectors, clips can be pinched or squeezed together, so that they will remain in place. To attach safety guards, remove reflector from wiring channel, insert clips through socket holes and slide them back over the reflector material. Wheeler Reflector Company, 275 Congress Street, Boston, Mass.



WHEELER LAMP GUARDS

JOB PROVED

in thousands of installations

Central Rigid Steel Conduit will give long reliable service even under the most difficult conditions. Practical experience in thousands of installations has proven this time and again.

SPANG-CHALFANT

Division of The National Supply Company

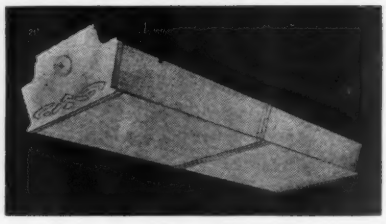
Executive Offices:

Grant Building, Pittsburgh, Pa.

District Offices and Sales Representatives in Principal Cities

Fluorescent Fixture

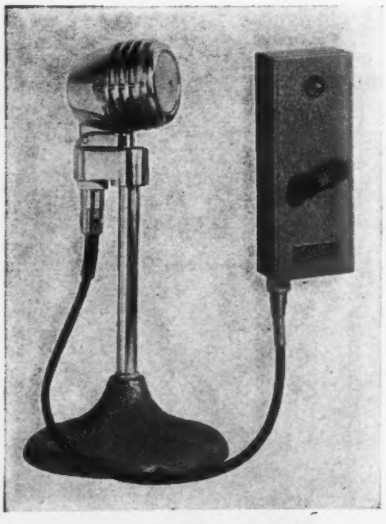
A new fluorescent unit for commercial use, built according to specifications of the Utilities Research Commission. The fixture, designated as URC-448, is made for four 40-watt lamps, with translucent diffusing glass panels at side and bottom. Unit complies with latest WPB limitations on the use of metal. It is for flush-to-ceiling, pendant or continuous row mounting. Glass panels are readily removed for cleaning and servicing lamps, and wiring is accessible from below. It is available with conventional type ballast and starters, or with "Insta-Lite", which combines functions of ballast and starter, providing instantaneous lighting. The Spero Electric Corporation, 18222 Lanken Avenue, Cleveland, Ohio.



SPERO FLUORESCENT UNIT

Microphone Control Box

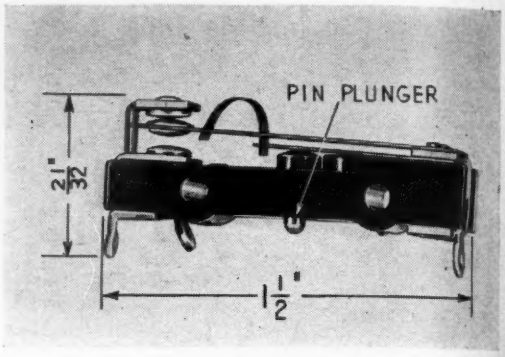
This new Model P566 relay and busy signal control box is connected to microphones in Executone's rack and panel amplifier sound systems. Installed with microphones in such locations as guard houses, reception desks, telephone switchboards and at plant broadcasting centers, it coordinates the operations of multiple microphones and provides an instantaneous method of cutting in on central plant sound systems. Busy signal light eliminates interruption from other microphones in the same system. Suitable for wall mounting, the unit is housed in gray metal cabinet, $6\frac{1}{2}$-in. high, $2\frac{5}{8}$-in. wide and $1\frac{1}{8}$-in. deep. Connections are made to terminal strips located inside the case. Executone, Inc., 415 Lexington Avenue, New York, N. Y.



EXECUTONE CONTROL BOX

Midget Switch

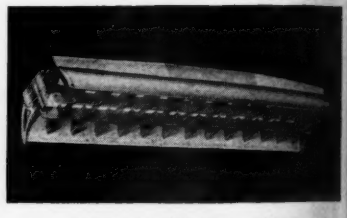
This new Acro-Snap midget switch, built on the rolling spring principle, is being made to the maximum dimension of $1\frac{1}{2}$-in. It is $\frac{9}{16}$-in. wide, $\frac{7}{16}$-in. thick and weighs less than an ounce. All component parts are non-corrosive. The switch is designed for actuation from either the top or the bottom. It is adapted to electronic control devices, machine tools, aircraft and electrical appliances. Both the snap-action spring itself and center blade are made of beryllium, while the base is of bakelite. It is furnished in single pole, normally open, normally closed, and double throw with both pre-travel and over-travel provided. Acro Electric Company, 1338 Superior Ave., Cleveland 14, Ohio.



ACRO MIDGET SWITCH

Fluorescent Fixture

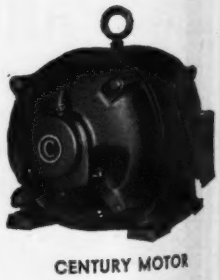
A new eggcrate-louvered luminaire conforming to latest WPB metal limitations has been announced. Known as the Futurliter, it is for use in offices and drafting rooms in war plants. It is of the open type construction. Designed for close-ceiling or ceiling-suspensions, it can be mounted singly, or end-to-end in continuous runs for 50 to 75 foot-candle installations. Each 48-in. unit can be had for use with either two or three 40-watt lamps. It is available with conventional ballasts with starter switches or with the new Quick-Liter ballast which uses no starter switches. The Edwin F. Guth Company, 2615 Washington Ave. St. Louis 3, Mo.



GUTH FLUORESCENT FIXTURE

Protected Motor

Form J, general purpose, open rated motors in a new protected design are available in sizes from $1\frac{1}{2}$ to 15 horsepower. The upper half of the end bracket is closed to minimize the possibility of dripping liquids or falling solids entering the vital parts of the motor. Two fans located behind the bearing brackets draw cooling air through the bearing bracket openings, around the bearings, across the windings and to the air passages between the outer surfaces of the magnetic core and the frame—the heated air being expelled through openings at the side and bottom of the frame. Century Electric Co., 1806 Pine Street, St. Louis 3, Mo.



CENTURY MOTOR

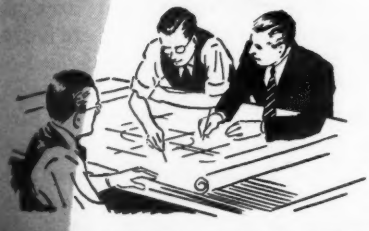
Monitor BALTIMORE, MD.

The Original "JUST PRESS A BUTTON" System

Versatility

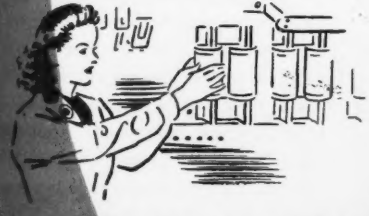
MONITOR SERVES THE ELECTRICAL INDUSTRY—

FROM PLANS



THROUGH DESIGN

AND FABRICATION



TO INSTALLATION

Monitor can serve you TWO ways!

If your requirements call for standard equipment . . . A.C. or D.C. Contactors, Motor Starters and Controllers, Push Button Control Stations, Rheostats, Resistors, Speed Regulators, etc . . . Monitor quality-built equipment will meet your most exacting specifications.

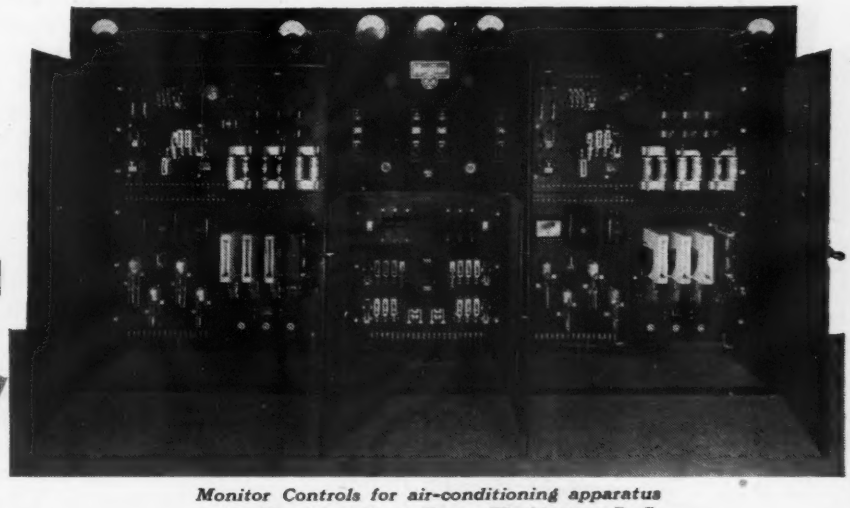
OR—if you require a complete custom-built control unit, Monitor engineers will design and build the unit to do the specified job.

Monitor custom-built units are fabricated from standard parts . . . a procedure that gives you appreciable advantages in cost and performance.

Specify **Monitor**

AUTOMATIC MOTOR CONTROL

It pays dividends in performance. Consult the Monitor Field Engineer nearest you.



Monitor Controls for air-conditioning apparatus in the Municipal Court House, Washington, D. C.

The Monitor Controller Company

GAY, LOMBARD and FREDERICK STS. ● BALTIMORE-2, MARYLAND

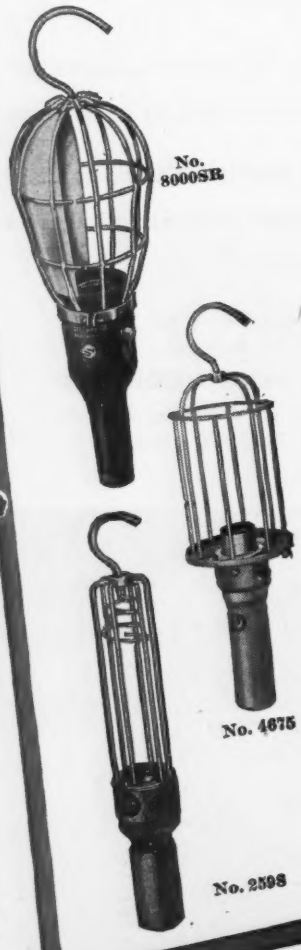
Branch Offices: BIRMINGHAM, ALA. • CHATTANOOGA, TENN. • BOSTON, MASS. • PHILADELPHIA, PA. • CHICAGO, ILL. • CLEVELAND, O. COLUMBUS, O. • DETROIT, MICH. • KALAMAZOO, MICH. • LOS ANGELES, CAL. • BALTIMORE, MD. • NEW YORK, N. Y. CINCINNATI, O. • HARTFORD, CONN. • BUFFALO, N. Y. • ST. LOUIS, MO. • WASHINGTON, D. C. • HOUSTON, TEXAS.

Canadian Affiliates: RAILWAY AND POWER ENGINEERING CORPORATION, LTD. • TORONTO, ONTARIO, CANADA.

WOOD does the Job

Rubber now is on the critical list which means that McGILL all-purpose wood handle guards will be used in affording protection in heavy-duty, high-pressure war industries . . . Over the years many large plants have found McGILL wood handle guards give complete satisfaction, because they're durable, wash easily, wear well in grease and oil. When you want portable guards, order McGILL wood handle guards. There is a type to fit every requirement.

Visit your wholesaler or write us for additional information.



No. 8000SR

No. 4675

No. 2598

Electrical Division

McGILL

MANUFACTURING CO., INC.
VALPARAISO, INDIANA

Fluorescents Reduce Accounting Errors

[FROM PAGE 43]

operate it and the adjacent fixture. The side offices (which are open above a four foot partition and adjacent to the public aisle) are equipped with the same type fixtures although installed at right angles to the main-aisle continuous row troffers. Three fixtures were mounted end to end in successive rows.

Readings on a light meter show that lighting intensities range between 45 and 50 foot-candles of maintained illumination in the back, low-ceiling area. The flush glass diffuser plates measure 16 feet 7½ inches from the floor. The two continuous-row aisle troffers are spaced 9 feet apart. The three fixture row units on the side are spaced on eight foot centers and terminate four feet from the wall at one end, six feet from the continuous aisle troffers on the other end.

This same pattern of continuous row lighting, parallel to aisles with side office fixtures mounted at right angles with three or four fixtures end to end (depending on available space) is used throughout the ground floor areas. The effect on the eye is very comfortable. The contrast provided by the dark veneer wood on the tellers' partitions and on the building columns, with the balance of walls, ceilings and floors finished in a light shade, give a very pleasing effect.

On the second floor, where most of the accounting is done, a broken-continuous row scheme is used. Because of building construction the continuous installation of flush fixtures could not be carried out. Units of four single tube 40 watt fixtures are mounted end to end with a three foot break in between because of building construction, and then another unit of four fixtures, and so forth across the width of the building. Center distances between rows measure five feet. Ceiling height is 13 feet 2 inches. Here again the maintained intensity is 50 foot-candles. Columns, walls and ceilings are finished in a dull white paint with a high reflection factor and with no glare.

It is interesting to note that total lamp wattage is the same as before, but foot-candles have been increased by 100 percent.

The Robinsons, Ralph and Roy, have been doing a fine job of selling and engineering many relighting and new lighting jobs both commercial and industrial. They have also figured prominently in electrical war construction in that section of the South.

Fundamentals of Electronic Tubes

[FROM PAGE 42]

cury pool and consequent heating of the mercury pool also account for some electron emission. The arc drop across a typical mercury arc tube is from 10 to 20 volts.

B. *Ignitron Tube*

The construction of a typical ignitron sealed-off type tube is shown by Fig. 31.

A spark is caused at the junction of the ignitor and the mercury pools which would in turn create a cathode spot. The igniter functions in the tube as a spark plug does in the cylinder of a gasoline engine.

This ignition method creates the cathode spot and current conduction in a few microseconds. There is no delay when the tube is placed into service. It does not require a keep-alive-arc which is usually associated with the conventional mercury pool tubes. After the arc has once been initiated, the tube will conduct current to the end of the particular half-cycle of voltage, at which time the reverse line voltage potential will reduce the current to zero and extinguish the arc discharge and cathode spot. The tube must be reignited for further current conduction and it can be precisely controlled by relatively small current impulses in the igniter circuit.

As the current conduction time can be definitely controlled to a fraction of a cycle and as the tube is not limited in frequency of operation as a conventional switch or contactor is limited by inertia of the moving parts, this tube is widely used and is very superior to a single pole contactor for current control in seam of spot welding. The tube is water cooled. Fig. 30 shows typical duty cycles and compares the short time and 100 percent averaging time current ratings. The duty cycle is a measure of how hard the tube is worked. It expresses the ratio of the current conduction time to a specified period of time known as the averaging time. The averaging time is a fixed time period set by the manufacturer on each type of tube.

In case of trouble the unit tube replacement expense is low as the trouble may be segregated to a single tube and not to the complete rectifier. The efficiency of some rectifier units approaches 98 percent which is superior to rotating conversion machinery. It is also quiet. Some ignitron rectifier assemblies have been built for an output of 5000 amperes at 600 volts.

Porcelain

PROTECTED WIRING SYSTEMS

THE SIMPLEST WAY

THE TRULY ECONOMICAL WAY

THE WAY THAT ASSURES PERMANENCE

for INDUSTRIAL-COMMERCIAL AND RESIDENTIAL WIRING

Porcelain Protected Wiring Systems fit into the war time picture perfectly. With steel and other critical materials drafted for implements of war, porcelain continues to prove the many advantages of non-metallic wiring. Today the knowledge of porcelain dependability—low cost—ease of installation—safety and corrosion resistance is more widespread than ever before.

Use porcelain to help in the critical material conservation program. At the same time get the benefits to yourself and for your customers—get liberal adequacy and capacity—save maintenance—make each job a more profitable one —think of the value of porcelain for those thousands of peace time jobs ahead.

For details write to any of the companies listed below.

PORCELAIN—a big aid in conserving critically needed materials

1 Releases steel and other critical materials for fighting equipment.

2 Makes possible a continuance of industrial, commercial, and residential wiring and is a natural for use in essential war construction.

3 Enables all wiring on the home front to be done quickly, adequately, and economically

★ **ILLINOIS ELECTRIC PORCELAIN CO.**
Macomb, Ill.

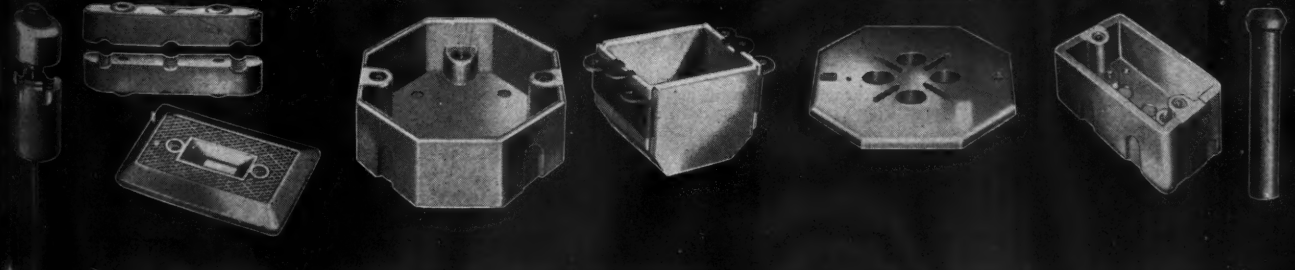
★ **PORCELAIN PRODUCTS, INCORPORATED**
Findlay, Ohio

★ **SPECIALTY PORCELAIN WORKS**
East Liverpool, Ohio

★ **SUPERIOR PORCELAIN COMPANY**
Parkersburg, W. Va.

★ **UNIVERSAL CLAY PRODUCTS COMPANY**
Sandusky, Ohio

MODERN PORCELAIN PROTECTED WIRING SYSTEMS



IN THE NEWS

IAEI BEGINS POSTWAR STUDIES

The postwar picture from the electrical inspector's viewpoint is being very carefully scrutinized by the International Association of Electrical Inspectors. Following the appointment of a Postwar Planning Committee by President Bowry, subcommittees were designated and subjects for investigation assigned.

The first direct action of this Committee was the laborious, yet vitally important, task of sifting through the numerous suggestions offered by the members. After all suggestions were carefully weighed, eight were selected as the subjects of greatest importance for immediate postwar consideration. Each subject was assigned for further study to a subcommittee, chairmanned by a member of the Postwar Planning Committee. Some of these have already been staffed; others have yet to be completed. The individual subcommittees and their chairmen are as follows:

Development of IAEI—chairman, M. F. Cody, New York

Sales Control—chairman, Wm. A. Cyr, San Francisco

The N. E. Code, Maintaining It and Keeping It Up to Date—chairman, Wm. A. Haig, Milwaukee; members—George Andrae, Milwaukee and M. H. Hedges, Washington, D. C.

Uniform Codes—chairman, A. M. Mc Lean, Portland, Oregon

Reinspections—chairman, V. C. Moulton, Denver; members—Wm. A. Haig, Milwaukee and George Welman, New Orleans.

Substitute Materials and Methods—chairman, R. B. Shepard, New York

Increased Load on Inadequate Systems—chairman, J. Hyde Stayner, Salt Lake City, Utah.

Education of the Inspector—chairman, George Welman, New Orleans.

With this as a starting point, the subcommittees are all set to go and solicit any suggestions and aid that members might be able to offer. Once each subject has been thoroughly investigated a definite program of action will be mapped.

"Very pretty, Miss Logan, but we splice wire a little differently than that!"

RESTRICTIONS ON COPPER FOR FUSES & WIRING DEVICES REMOVED

Restrictions on the use of copper and copper base alloy in renewable electric fuses and electrical wiring devices have been removed by the War Production Board. Steel has been used in the manufacture of these products under the provisions of Orders L-161 (Electric Fuses) and L-277 (Electric Wiring Devices) since issuance of the orders in August, 1942, and April, 1943, respectively.

The return to permitted use of copper and copper base alloy, effected by amended versions of both orders, will result in a considerable saving in man-hours, increased production, and more satisfactory products. Production of electric fuses has been seriously curtailed by the additional screw machine time required to process steel, and by the difficulty in obtaining prompt deliveries of steel rod. Wiring devices made from steel corrode after a few week's use, it has been found, and become inoperative.

Control over the distribution of the products remains unchanged, except that a rating of AA-5 or higher is required instead of a rating of A-1-j. This change is made to conform with over-all changes in the rating structure.

Non-renewable fuses are still subject to the restrictions on the use of copper and copper base alloy.

MOTOR EQUIPMENT REPAIRMAN ADDED TO CRITICAL LIST

"All-around repairman of electric-motor equipment" has been added to the list of critical occupations compiled for the guidance of National Selective Service by the Man Warpower Commission.

Holders of critical occupations in essential industries are eligible for occupational deferment from military service, and special appeals procedure is provided for their employers when such workers are scheduled for induction by local draft boards. Critical occupations are determined by shortages of skills so acute as to impede or threaten to impede war production, by length of training and experience necessary for qualification, by their

Re-conversion *will not be a serious problem with us*

LIKE MOST other manufacturers, we have had to strain our facilities to the utmost to supply the demands of the present emergency. While some of the products we are producing for war purposes are "special," much standard FA Electrical Equipment has fitted perfectly into the war picture. And, where priorities permit, we are still manufacturing for non-war use. . . . At the same time, we have found it possible to continue with the development of new products. . . . So, when Victory comes, we will be able to turn at once to the production of equipment for industrial, commercial and residential use.

Among the new FA Products now available are

KLAMPSWITCHFUZ SWITCHBOARDS

These are assembled of standard units of similar or varied capacities, in either Dead Front or Safety Type Switchboards.

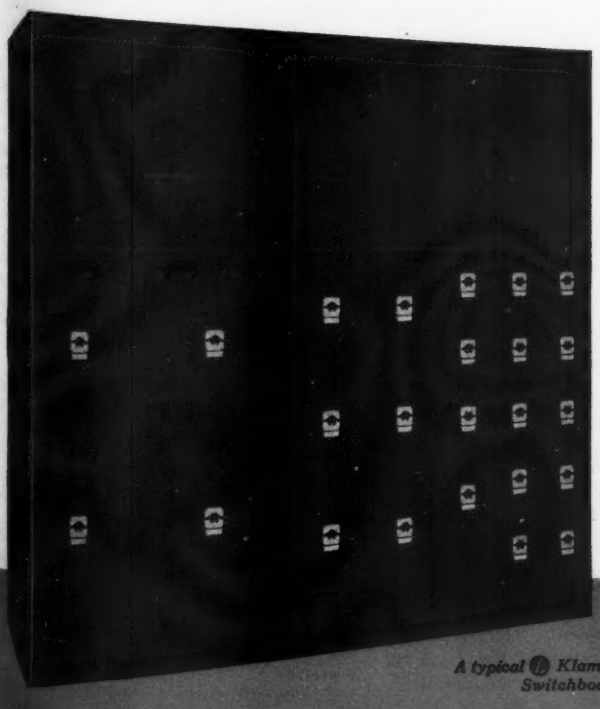
The face appearance of both is identical. The Dead Front type is open at the rear, which requires a protective grill to prevent access to current-carrying parts. The Safety Type is equipped with steel doors at the rear.

Each FA Klampswitchfuz unit is of the hinged type. The basic design is that of the knife switch—that is, the insertion of a blade into a contact clip. In the ON position the switch blades make *pressure contact* with the slots in the base, and are thus drawn tightly together at the fuse contacts. This, with the silver-plated contact parts, assures low-resistance to current flow.

Switch and fuse are combined in one unit, so that accidental contact with live parts is impossible when the door is closed.

FA Klampswitchfuz units are made in capacities of 30 to 1800 amperes, inclusive, 250 volts AC and DC, and 30 to 600 amperes, inclusive, 575 volts AC, in 2, 3 and 4 pole types, single and double throw. They are approved by Underwriters' Laboratories, Inc., as operating switches for 600 amperes and less, 250 volts AC and DC, and 200 amperes and less, 575 volts AC. All other capacities are approved as disconnect switches only.

FA Klampswitchfuz Switchboards are completely assembled at the factory, and shipped ready for connection of main feeder and branch circuit cables.



A typical FA Klampswitchfuz Switchboard

For the latest Engineering Data on FA Switchboards consult an FA Sales-Engineer. By long experience, he is competent to help Architects, Engineers and Specification Writers in problems of designing and specifying electrical installations. Write for name and address of the one nearest you. No obligation . . . Frank Adam Electric Co., Box 357, St. Louis, Mo.

EST. 1891 — THE SIGN OF A BETTER JOB
Frank Adam
ELECTRICAL PRODUCTS
for War Industry
FRANK ADAM ELECTRIC CO. ST. LOUIS, MO. U.S.A.

inability to be filled satisfactorily through upgrading, and by the necessity of the job to the maintenance of achievement of war production schedules.

S. J. O'BRIEN ELECTED PRESIDENT OF NEW YORK ASSOCIATION

S. J. O'Brien, president of S. J. O'Brien, Inc., well known electrical contractor, was elected president of the Electrical and Gas Association of New York Inc. at its annual meeting held on January 19.

Other officers elected were: first vice-president, T. F. Barton, vice-president

S. J. O'BRIEN

General Electric Company; second vice-president, T. H. Joseph, president, E-J Electric Installation Co.,; third vice-president, Norman L. Myers, Eastern Manager, Electric Appliance Division of Westinghouse Electric and Manufacturing Co.; fourth vice-president, H. C. Calahan, District manager, General Electric Supply Corp; treasurer, James A. Sackett, sales manager, Kings County Lighting Company; secretary, C. A. Norton, sales manager, Pierce Laboratory, Inc.; and assistant secretary, John W. Walter, Manager, Eastern Division, Apex Rotarex Corporation.

OSTERBERGER HEADS NEW ORLEANS GROUP

C. L. Osterberger, Louisiana Power & Light Co., was elected president of the Electrical Association of New Orleans at the final 1943 meeting held at the St. Charles Hotel. He takes over the duties of retiring president J. Otto Kaelin who became a member (ex-officio) of the executive committee.

Vice-presidents elected to represent the various phases of the electrical industry include: P. E. Lehde—executive vice-president; O. P. McCord—wholesalers, utilities, manufacturers; F. Stern—refrigeration; W. J. Barnes—electrical contractors; L. C. Reed—air conditioning, ventilation; and J. W. Schroeder—radio. Other officers are: J. R. Guidroz, secretary; I. W. Tufts, treasurer; and W. E. Clement, director of publicity.

Executive Committee members are: Rudolph Viener, W. B. Meek, E. N. Avegno, W. B. Wands, A. B. Lindauer, C. S. Green, N. Braselton, Paul Hogan and J. Otto Kaelin (ex-officio).

SHEPARD RETURNS TO UNDERWRITERS' LABORATORIES

Robert B. Shepard resigned December 31, 1943 as assistant director of the Conservation Division of the War Production Board, Washington, to devote full time to his regular position as chief electrical engineer of Underwriters' Laboratories at its New York office, 161 Sixth Avenue.

Mr. Shepard's duties while he was on loan from the Laboratories were to set up programs for simplifying products so as to release critical materials and manpower for the war effort. He will continue to serve as the Division's representative in contacts with the American Standards Association.

LIMITATIONS ON WIRE, CABLE & CABLE ACCESSORIES WITHDRAWN

Withdrawal of the limitation on the effective period during which sellers other than manufacturers were permitted to adjust their maximum prices on wire, cable and cable accessories if they were based on lower supplier's prices than those in effect to them on October 15, 1941, has been announced by the Office of Price Administration.

This action provides a measure of relief to those sellers whose prior cost increase could not be reflected in their selling prices under the more rigid limitations of the former provision.

Under this action the seller is allowed to increase his base date (October 15, 1941) selling price by the same percentage as the supplier increased the price to him.

Sellers who desire to make such adjustments are required to report to OPA (1) the name and address of the immediate supplier as well as the manufacturer of the item, (2) a description of the item, (3) the supplier's price on the base date, had a purchase been made, and the date such price became effective, (4) cost upon which seller's base date selling price was calculated and period during which cost was effective, (5) seller's net price in effect on base date and date such price became effective, (6) seller's maximum price and the class of purchaser to which each price applied.

(Amendment No. 5 to Revised Price Schedule 82, effective December 29, 1943.)

NEW ELECTRICAL CODE FOR NEW YORK CITY

The City of New York adopted a new Electrical Code on December 27, 1943. A new section on fluorescent lighting appears in this Code which may become the pattern for code rules in other municipalities. The section reads as follows:

§ B30-125.0 *Fluorescent tube type lighting fixtures.*—a. General.—1. This type of fixture is designed for general illumination purposes and utilizes gaseous tube lamps of the electric discharge type, employing mercury vapor as the medium for sustaining the arc. The arc produces ultra-violet radiation which in turn is transformed into longer wave lengths visible radiation by Fluorescent powders applied to the inner surface of the glass tube and are energized by control equipment consisting of choke coils, transformers, resistors, lamp starters, capacitors, relays and the like, installed within the fixture proper, or installed in a metal cabinet outside of the fixture.

2. Fixtures shall be so designed that they may be suspended by chains, stem hangers, mounted on the ceilings or walls or may be fully or partly recessed into the walls or ceilings of fireproof or non-fireproof constructed buildings.

3. Fixtures shall be employed on alternating current circuits, unless the fixtures are designed and equipped with auxiliaries and resistors specially designed and approved for direct current operation.

4. Fixtures exposed to the weather, moisture, condensation or corrosive vapors shall be of weatherproof type.

5. Fixtures where exposed to hazardous atmospheres, shall be of a type especially designed and approved for the specific type of hazardous atmosphere.

6. Lamp holders, auxiliaries, series reactors, starters or glow switches, thermally operated switches, transformers, auto transformers, choke coils, capacitors, condensers, ballasts, relays, resistors and all other electrical devices or apparatus found necessary for the proper operation of Fluorescent tube lighting must be of a type especially designed and approved for the purpose. When any of the above appliances are installed separately they shall have the manufacturer's name, or trademark, ratings and type number placed on each item. In cases where the manufacturer places more than one of the aforesaid appliances in a single sealed metal case, and known as a "series starter", "control unit", or "auxiliary" the manufacturer's name or trademark, type of unit, number and size of lamps, wattage and voltage must be placed on such units in a permanent manner, so that such information will be visible for inspection after installation.

7. All such type fixtures shall be constructed, wired and installed so as to conform with the following:

b. Fixture construction.—1. The design and construction of the fixture shall be such as to secure ample strength and rigidity.

2. Fixtures shall be constructed entirely of metal or other materials as may have been submitted for examination and approved. (*Ed. note: Non metal reflectors and other war emergency types are covered under separate department bulletins.*)

3. For all surface mounted, suspended type and wall bracket fixtures, the enclosure housing the auxiliaries, and wiring within, having a cubic content of fifteen

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Coat pocket "shipment" launched Navy boat

Rush Trip By Wesco Man For Electrical Pushbuttons Assured On-Time Christening.

The champagne bottle was be-ribboned and the compact Navy boat stood poised on the ways ready to slide into Massachusetts Bay. Suddenly it was discovered that pushbuttons, essential to the many electrical operations aboard the vessel, had never been ordered. After a thorough search of the vicinity verified that buttons of the right types and sizes were unobtainable, there was a confused halt in launching plans.

Arriving at the shipyard in answer to an urgent call, the Wesco man went into action; in a few minutes he was on a train speeding to New York. Early the next morning he was back in the yard, his coat pockets bulging with the pushbuttons —so little in size, so vital in importance. Thanks to Wesco's unconventional service the situation was saved and the launching took place as scheduled.

Wesco's uncanny ability to get things done in the face of obstacles and emergencies has speeded many a wartime job to early completion. Your present and postwar problems will be solved more easily if you employ the services Wesco can place at your disposal.

WESCO SPEEDS WAR PRODUCTION

* To start production, a powder plant required special floodlights. Best quoted delivery involved a paralyzing 14-week delay. Wesco contacted a manufacturer and delivered the "floods"—in only 10 days!
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* By providing trained sales and engineering personnel.
* By buying large quantities at low prices and passing the savings on to small-quantity buyers.
* By assembling all parts of an order in one shipment.

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A NATIONAL DISTRIBUTING ORGANIZATION WITH 80 BRANCHES

Tune in John Charles Thomas, NBC, Sundays, 2:30 P. M., E. W. T.

FLAMENOL Building Wire is not a new and untried product. It was developed before the war and has been used in all sorts of buildings. What is more, wires with Flamenol thermo-plastic insulation have been used for a much longer time—switchboard wire, wire for signal circuits, machine tools, etc. It is approved by the Underwriters'.

Flamenol Building Wire is available now in sizes 14 to 1,000,000 CM. (Resins are permitted for electrical conductor insulation wherever copper is allocated.) Use this wire for the war-purpose jobs you are handling. It is easy to use and will give long service.

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Look at the Features

1. Small in diameter — Saves space.
2. Superaging—Long life, no oxidation.
3. Easy pulling — Hard, smooth finish.
4. Heat resistant — Rated 60 deg. C.
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8. Insulation — Tensile strength of 2000 lb. per sq. in., test result
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10. Oilproof — Unaffected by oils, water, acids, alkalies
11. Attractive — Retain fine appearance
12. Self-protecting—No braids necessary

*Reg. U.S. Pat. Off.

GENERAL ELECTRIC

hundred cubic inches, or less, shall be constructed of sheet steel not smaller than no. 20 U.S.S.G. (0.0375 inch.) Enclosures having a cubic content of over fifteen hundred cubic inches shall be constructed of no. 18 U.S.S.G. (0.0500 inch) sheet steel—

(a) Except where the cover of the enclosure does not support lamp or starter holders, auxiliaries or other equipment, but serves only as a cover, no. 20 U.S.S.G. (0.0375 inch) sheet steel or equivalent may be employed. If fixtures are connected end to end, the above shall apply to each section of the extended fixture.

(b) Reflectors constructed of aluminum and which may be detached from the body of the fixture and employed to close one side of the enclosure, may be constructed of aluminum having a thickness of not less than 0.0312 inches provided the auxiliaries or other devices are not mounted on the reflector.

4. Recessed or partly recessed type fixtures shall be constructed of sheet steel not smaller than no. 18 U.S.S.G. (0.0500 inch).

5. Enclosures may be constructed of metals, other than sheet steel, provided they are equivalent in mechanical strength. Sheet aluminum, brass or copper having a thickness of 0.040 inches will be considered the equivalent of no. 20 U.S.S.G. sheet steel. Metals not of corrosive resistive type, shall be well galvanized or otherwise properly coated with zinc or other approved heat resistant material, inside and out, to prevent corrosion.

6. The seams, other than lapped type, of the metal enclosure shall be continuously welded, spot welded, riveted or bolted. When rivets, bolts or spot welds are employed for fastening seams they shall be placed not more than three inches apart and not more than one and one-half inch from each end. Bolts must be so installed, or protected, that the screw threads shall not expose the insulation of the electrical conductors within the enclosure to abrasion. The use of solder shall not be employed other than to seal the seams or to secure bolts or nuts from turning.

7. All completely threaded through bolts shall be provided with sleeves which will cover that portion of the bolt which passes through the enclosure, so as to protect the insulation on the electrical conductors from abrasion.

8. Fixtures designed so that they may be screwed or plugged into a lamp holder or be conected to a shade or globe holder, secured by means of metal clips or screws, thereby mechanically supporting the weight of the fixture on the lamp, shade or globe holder, shall not be permitted.

9. Fixtures shall be so designed that they will be installed, wired and connected in a permanent manner.

10. Recessed or partly recessed type fixtures shall be provided with knockouts for connecting flexible metallic conduit and means shall be provided to properly secure the fixture in place with at least four screws or bolts, or other approved methods.

11. All fixture enclosures shall be designed or ventilated to insure proper dissipation of heat and to operate at a temperature which will not damage or cause deterioration of the wiring or control apparatus.

12. Fixtures shall be so constructed that the enclosure housing the lamp holders, wiring, starting and control apparatus will be accessible for inspection after they are installed.

13. Lenses or glass panels shall be mounted or secured in a suitable frame

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COMPLETELY INSULATED

ALL PORCELAIN WIRING SYSTEMS . . .

PORCELAIN CONFORMS TO THE NATIONAL ELECTRICAL CODE

TOGGLE SWITCH PLATE

Look for this Trade Mark

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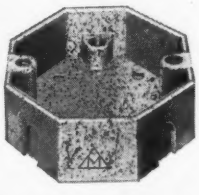
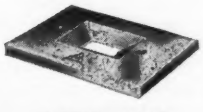
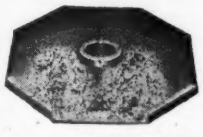


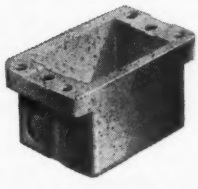
STANDARD KNOBS



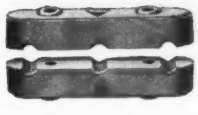
SWITCH BOXES AND COVERS



OUTLET BOXES AND COVERS



DUPLEX RECEPTACLE COVER



CLEATS

★ Contractors everywhere know that Porcelain in large quantities is available —that, therefore, they can do wiring jobs today with no let down in wiring quality —that they still can assure customers of permanency, dependability, and economy—that simplified modern installations are the result of the use of All Porcelain Wiring Systems.

This all means continued business for you — wiring goes right along — porcelain products are in demand. So, as those calls come to you for porcelain, be sure you are prepared with ILLINOIS PORCELAIN.

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Illinois all porcelain wiring systems are adaptable to practically all wiring plans and layouts. They can be installed without grounding.

Illinois ELECTRIC PORCELAIN CO.

MACOMB, ILLINOIS

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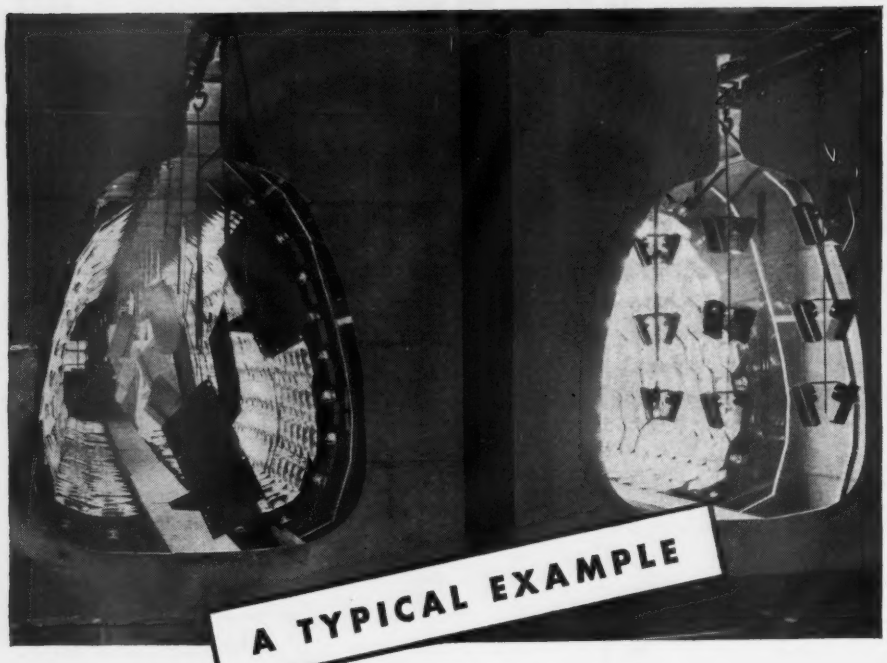

The Operation

To speed output of scout cars, prime movers and commercial trucks, a prominent truck manufacturer sought means to eliminate constant bottlenecks in the finishing line. Nearly every part in the complete fabrication of these units was either finish-baked by gas ovens or cured by air-drying.

The Solution

Pre-testing by Fostoria Industrial Service engineers proved conclusively the greater baking speed of the Near Infrared Process, its adaptability to continuous line production and reduced floor space requirements. Installation of eight tunnels was made including four tunnels suspended from the ceiling. Baking time factors now show a speed-up of 4 to 5 times over previous methods. Finishes are smoother and harder. Parts move from the baking zone on conveyors to dovetail with assembly line needs.

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to support the weight of the glass, and be held in place by means of a trough or by special clamps or clips secured to the frame. Frame clamps or clips shall be constructed of sheet steel not less than no. 27 U.S.S.G. (0.0172 inch) or other metal equivalent in strength. When clamps or clips are employed they shall be spaced not over one and one-half inches from corners and at intervals of not over three inches. In setting the clamps or clips, provision should be made for the expansion and contraction of the glass panels or lenses. Frames shall support only the glass panels or lenses and shall be mechanically secured to fixture enclosure by means of removable bolts or nuts, and means shall be provided for relamping and cleaning.

14. Frames containing glass panels or lenses, not over one-quarter inch in thickness and not over two hundred and fifty square inches in area, may be secured to a special cover or to a fixture enclosure by means of at least two hinges and a suitable spring latch designed for the purpose.

15. Suspended type fixtures equipped with a canopy, also the back plate enclosing the fixture, if constructed of metal less than no. 16 U.S.S.G. (0.0625 inch) shall be so designed that the weight of the fixture will not be dependent upon the canopy or back plate, unless it is properly reinforced to give equivalent rigidity, in which case it shall not be less than no. 18 U.S.S.G. (0.0500 inch) steel.

16. Back plates or covers of fixtures shall be secured to the body of the fixture by means of screws, bolts or clamp-on method, and screws or bolts shall be placed not more than eight inches apart nor more than one inch from each end, if they support the auxiliary equipment, glass panels or louvers. In cases where the cover is employed only to enclose the fixture, it shall be supported by means of screws or bolts at a sufficient number of points to prevent sagging or to permit any openings in the enclosure. Where clamp-on method is employed on fixtures having more than two lamps mounted parallel, the cover of the enclosure must be secured by through bolts. This paragraph does not apply to "surface metal raceways."

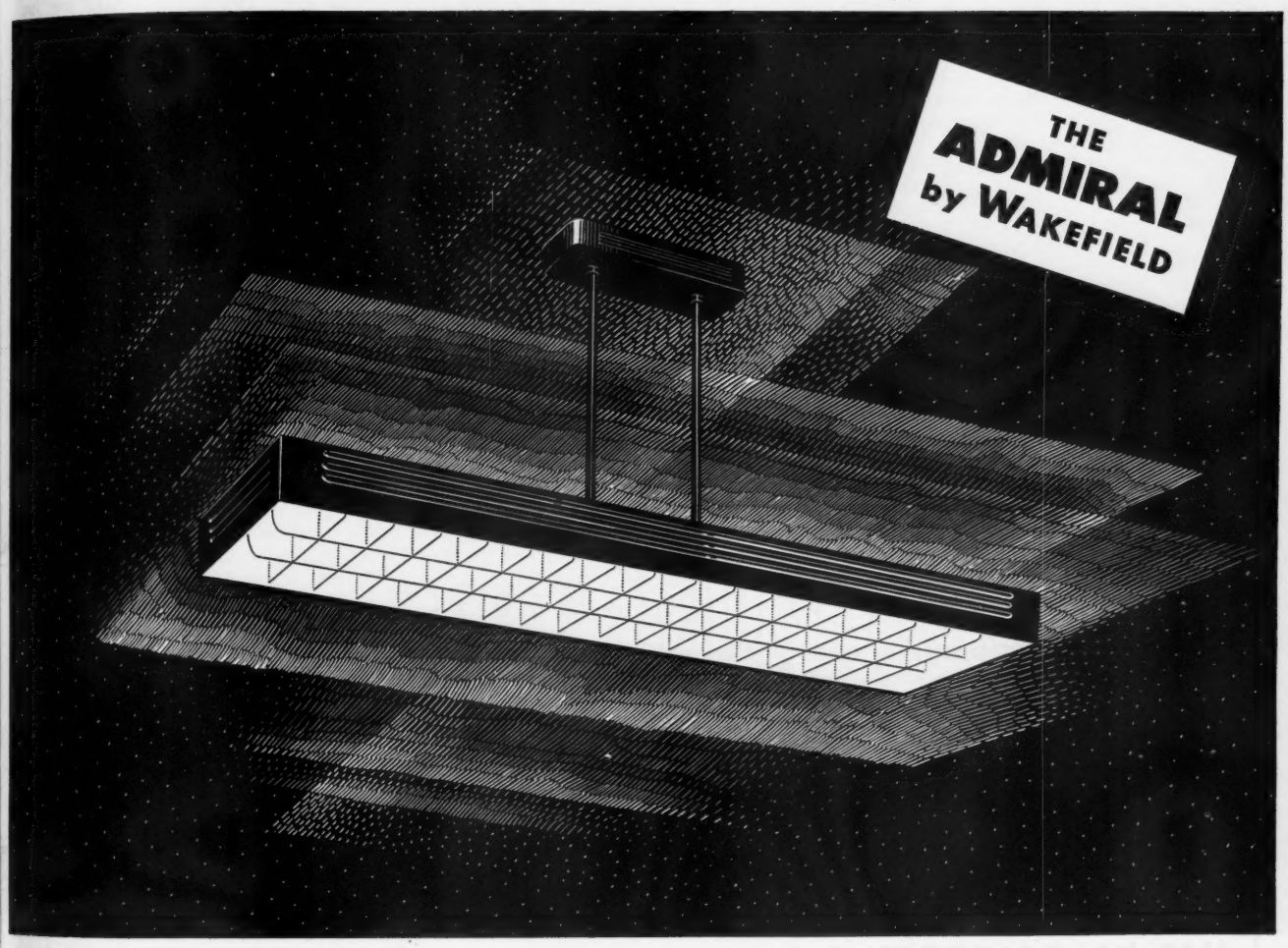
17. Fixtures weighing twenty-five pounds or more and suspended from one outlet box by two or more hangers shall be supported by means of strap iron one-eighth inch thick by one and seven-eighths inches wide, where the hangers are eighteen inches or less apart and when over eighteen inches the strap iron shall be one-quarter inch thick by one and seven-eighths inches wide. A hole shall be provided in the center of the strap iron so as to provide means of attaching it to a standard fixture stud or hanger. Hangers shall be secured to the strap iron by means of threaded lock nuts and bushings or fittings approved for the purpose. Other equivalent methods may be employed.

18. Due to variation in manufacture, a plus or minus thickness tolerance of ten per cent variation will be permitted for sheet steel.

19. Canopy switches controlling one, and up to, and including four Fluorescent auxiliaries shall have a current rating not less than six amperes at one hundred and twenty-five volts or a switch having a lower rating if especially designed and approved for Fluorescent lighting. Switches controlling over four lamps shall have a current rating not less than double that of the lamps.

20. Flush switches and convenience plug

For lighting war plant OFFICE or DRAFTING ROOM



. . . Effective . . . Efficient . . . Attractive!

PLEASING to look at, "tops" to see by, and built for service . . . that's the ADMIRAL! It is a natural for lighting essential office or drafting room. Tell your customers!

Made largely from wood, the ADMIRAL conserves war material and meets WPB limitations on use of metal. At the same time, it provides efficient, high intensity, diffused fluorescent light to help handle wartime paper work faster, with less eye-strain.

The ADMIRAL puts 90% of its light down on desk tops or boards and allows the rest to go upward to avoid ceiling contrasts. This makes it especially effective for work that involves critical seeing or for relighting older office space which has poor ceilings. Walnut finish outside, white enamel inside. Comes in 2, 3 and 4-lamp units. Write us for details that will help you serve your customers.

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RED SPOT LIGHTING FOR WAR PRODUCTION . . . FOR PEACETIME FUTURE

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With "synthetic rubber" insulation which, during the past two years has gradually taken the place of natural rubber compounds. Performance records already promise an important future for Simplex "synthetic rubber" insulation for power, communication and control cables.

Subject to W.P.B. Regulations.

With varnished cambric insulation for high voltage over short distances. Particularly suited for station or power house wiring and where operating temperature is high. Varnished cambric insulated cables may be covered with weatherproof or flameproof braids, lead sheath or steel armor.

With impregnated paper insulation for transmission of large blocks of power at higher voltages. Paper insulated cables are lead sheathed to keep moisture out. Best results can be obtained when cables are specially designed for the work they are to do.

If your postwar plans call for new cables — submarine, underground or aerial — for repairs, replacements or expansion, we shall be pleased to tell you what we can do for you now to help you prepare for the change from war work to "business as usual." It will be greatly to your advantage if you act quickly when the time comes.

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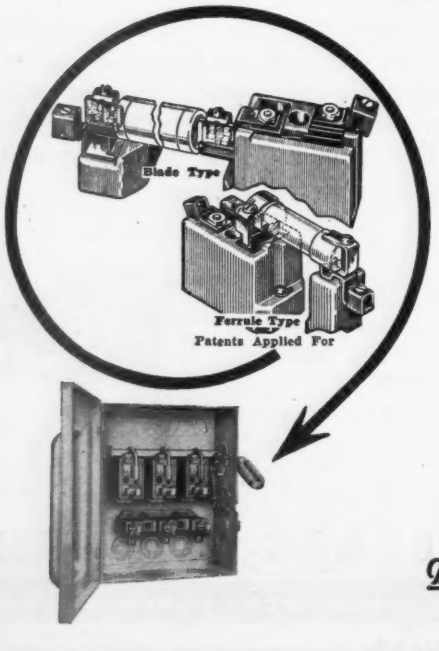
FUSES TOO HOT?

Maybe it's from poor contact between fuse and clips

STOP IT

USE WADSWORTH Safety Switches with

FUZE-TALONS



FUZE-TALONS: The Wadsworth new development illustrated are designed on the "High Pressure Line Contact" principle. They Hold Tight and conquer vibration.

Standard on Wadsworth Type "A" and Type "C" Safety Switches 60 amperes and up.

Sold through Leading Electrical Wholesalers.

The WADSWORTH ELECTRIC MFG. CO. INC.
Covington, Kentucky

outlets installed in Fluorescent lamp fixtures shall be separately enclosed and shall not be exposed to the heat from the auxiliaries or resistors.

21. Auxiliaries and resistors shall not be installed back to back, mounted on top of each other, or grouped in one portion of the fixture enclosure. They must have a spacing of at least two inches between sides and not less than one inch from the ends.

22. An air space of at least one-quarter inch shall be provided between the auxiliaries or resistors and the mounting surface.

23. They shall be secured in place in a permanent manner by means of screws, bolts, or specially designed and approved clamping devices.

24. Fluorescent lamp fixtures may be operated on direct current circuits by connecting one or two approved fixed resistors, of the proper value and type, to limit the lamp current in series with the auxiliary.

25. The separately mounted resistor shall be connected in either side of the line so that it will be connected in series with the tube and auxiliary during normal operation.

26. The following table gives the required fixed external resistance values for direct-current thermal switch type auxiliaries for 15 or 20 watts, 110-125 volt lamps; or 30 or 40 watts, 220-250 volt lamps:

Lamp Size	Normal D. C. Circuit Voltage	D.C. Lamp Current	External Fixed * Resistance Required
T 8—18"-15 watt	120	0.30	198 Ohms
T12—18"-15 watt	120	0.31	190 Ohms
T12—24"-20 watt	120	0.31	144 Ohms
T 8—36"-30 watt	240	0.33	*210 Ohms
T12—40"-40 watt	240	0.34	*170 Ohms

* For these lamps two fixed resistors connected in series are required for each lamp.

27. Each completely wired fixture shall be provided with a permanent name plate or marking, stating the makers or assembler's name or trademark, voltage and type of current and shall be installed in a permanent manner so that it will be visible for inspection. Name plate or marking shall not be less than one and one-half inches long by one-half inch wide. The use of paper stickers shall not be permitted.

c. Installation.—1. Fixtures shall be installed and connected in a permanent manner to an existing lighting outlet or to an outlet installed for the purpose.

2. In no case shall combustible material, adjacent to the fixture, be subjected to temperatures in excess of one hundred and ninety-four degrees Fahrenheit (ninety degrees Centigrade).

3. No Fluorescent lighting fixture whose temperature exceeds one hundred and twenty-two degrees Fahrenheit, shall be placed over any lighting outlet housing type R rubber covered conductors.

4. Fixtures employing more than one Fluorescent tube lamp, (parallel) mounted on wooden lath and plaster walls or ceilings, or a ceiling or wall constructed of combustible material shall be provided with at least one-half inch air space between the fixture and the finished ceiling or wall. This paragraph does not apply to a single strip surface metal raceway.

5. Where recessed or partly recessed type fixtures are installed in non-fireproof and semi-fireproof buildings, all woodwork and other combustible materials within eight inches of the fixture must be fire-

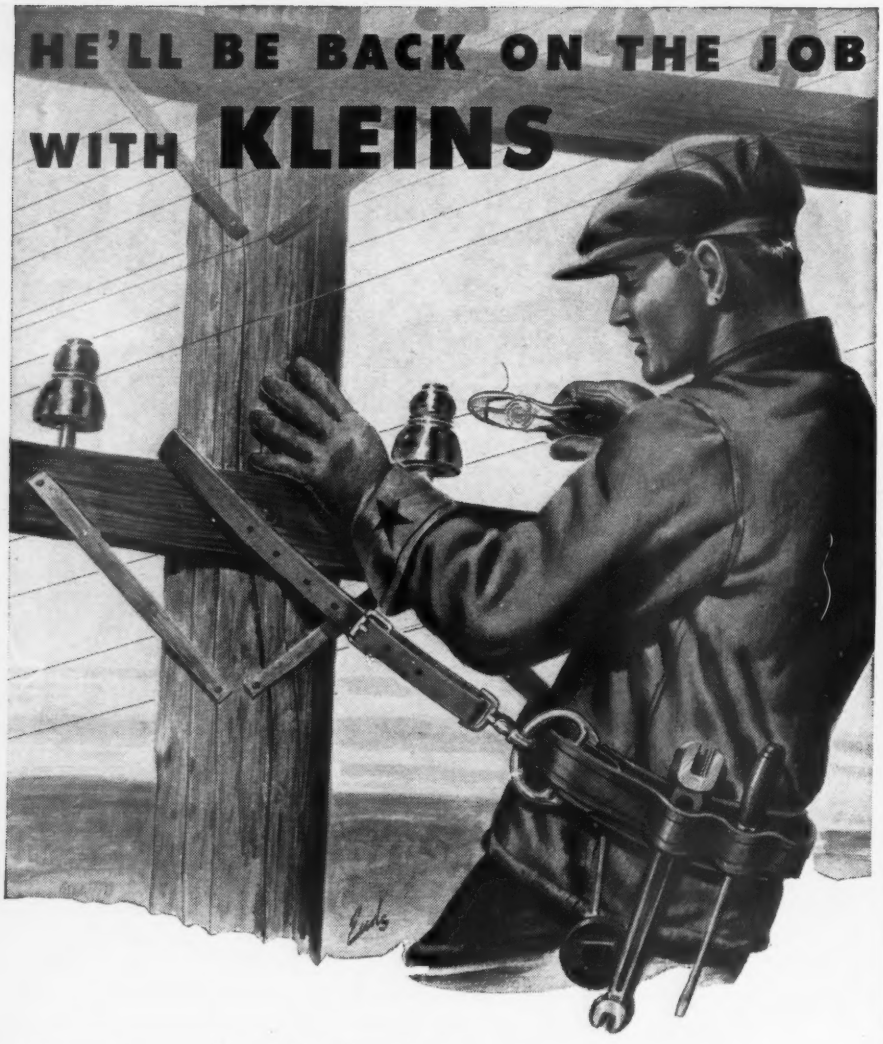
IT STANDS ALONE

—with over 50 years of skill and experience behind it, exclusively devoted to the design and manufacture of electrical devices for circuit protection. It stands alone, also, in the number of its features which make for simplicity and sturdiness of construction, ease and swiftness in renewal, and complete dependability. The Shawmut Shur-Lag Renewable Fuse is the fuse of today, for tomorrow; there is nothing to surpass it in its field. If you are not familiar with the details that make it the fuse for you to use, you should be; for today they can be of exceptional service to you in preventing stoppages and breakdowns in production, while giving your circuits and their equipment complete protection. Ask your dealer, or write for our Bulletin 400.

The Chase-Shawmut Company
Newburyport, Massachusetts

Fuse makers S *since 1893*

HE'LL BE BACK ON THE JOB WITH KLEINS



WHEN the war is won the planned program of communication and power line expansion will begin. The man on the pole will again be calling for Kleins.

He can be assured of the same high quality that has characterized the name Klein since the first wires were strung nearly a century ago.

Today, Klein production of pliers and tools, climbers and grips, safety straps and belts is greater than ever before. For this equipment is essential in keeping communication lines humming at home and on the battle front—in keeping power flowing to speed the world's greatest industrial production.

Tomorrow, public utility companies are assured that this stepped-up production will aid them in the important job ahead—providing better communications—greater power for an America at peace.

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International Standard Electric Corp., New York

Every broken tool is a break for Hitler! It is important that tools be properly used and properly cared for. The Klein booklet "Long Life to Tools" giving valuable information on the proper use and care of tools will be sent on request to anyone interested.

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3200 BELMONT AVENUE, CHICAGO 18, ILLINOIS

proofed with one-quarter inch asbestos board securely held in place by screws.

6. Fireproofing must be inspected and approved before the fixtures are installed.

7. Openings in the walls and ceilings shall be framed with angle iron, a specially constructed frame or other suitable means for securing the fixture enclosure.

8. Fixtures shall be so installed that they may be removed without damage to the walls or ceilings.

9. Where standard surface metal raceways are employed for housing Fluorescent lighting, they will be approved for exposed work only, and not for recessed or partly recessed installation.

10. Resistors designed for direct current operation shall not be placed in any standard surface metal raceways measuring less than three inches wide and one and three-quarter inches deep, unless the combination is especially approved, with less cross sectional dimensions of enclosure.

11. Not more than fifteen single or two lamp type auxiliaries shall be placed on any single fifteen ampere branch lighting circuit.

12. All metal parts of the fixtures shall be permanently and effectively bonded and grounded.

d. Fixture wiring.—1. Fixture wire shall not be smaller than no. 16 A.W.G., copper stranded, Type AF asbestos covered, or CF, if the temperature of the enclosure does not exceed one hundred ninety-four degrees Fahrenheit (ninety degrees Centigrade).

2. The wire for recessed or partly recessed fixtures shall be carried from the fixture in flexible metallic conduit for a distance of not less than four feet and not more than six feet to a standard outlet or junction box which will be at least one foot away from the fixture. Such boxes, when located in a hung ceiling, will not be considered as concealed provided they are accessible when the fixture is removed.

3. Type R rubber covered conductors shall not be employed for wiring any type of Fluorescent lighting fixtures.

4. The fixtures shall not be used as a splicing chamber for other circuits or a common raceway for other conductors.

5. No live parts shall be normally exposed within the fixture.

SNAPPED IN A JOVIAL MOOD are Wallace Hank's three right hand men of the Southern Electric Service Co. Inc., Charlotte, N. C. Left to right they are: J. T. Meador, C. A. Morris and H. S. Furman. All three carry the title of manager and their responsibilities are respectively: construction and engineering; fractional motor repair; and three phase motor and transformer repair.

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Completely modern, the new Robbins & Myers Uni-Shell Direct Current Motors combine ease of commutator and brush inspection with maximum mechanical protection. In performance, too, they offer real protection against high maintenance costs and time-wasting delays. All types, whether shunt or compound-wound, contain interpoles that assure long, trouble-free operation with good commutation and minimum brush and commutator wear.

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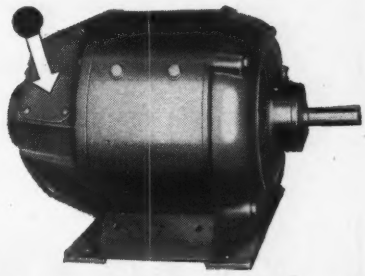
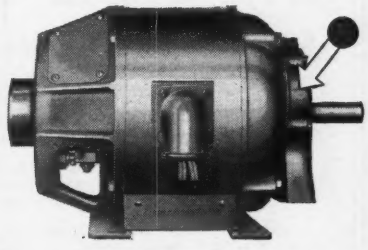
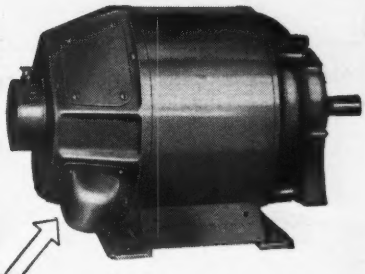
Ample stock on all types of integral motors on hand as this goes to press. Wire or phone your inquiry.



● **Open-type motor end head design guards against falling foreign material.**



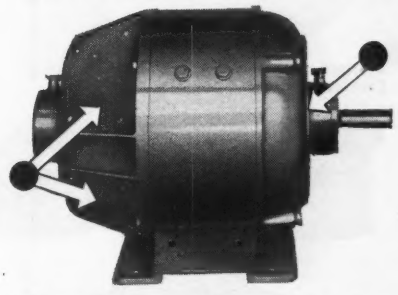
● **Protected open-type made drip-proof by addition of cover plate to shaft-extension end of motor.**



● **Drip-proof type made splash-proof, too, by protective covers on bottom of end head.**

It's Free!

MAIL THIS COUPON NOW!



● **Totally enclosed type without ventilating openings in shaft-extension end head . . . plates on commutator end head cover both top and bottom openings.**

EC11

ROBBINS & MYERS, INC., Motor Division, Springfield, Ohio
Please send my free copy of the new, informative Uni-Shell Motors booklet.

Name.....*Dept*.....
Company.....
Address.....
City.....*State*.....
I would ☐ would not ☐ like to talk to a representative.

A Complete Line of

BAKELITE
OUTLET BOXES *and* COVERS

THAT MEET THE NATIONAL ELECTRICAL CODE AND APPROVED BY FEDERAL HOUSING ADMINISTRATION

BOXES FURNISHED WITH OR WITHOUT CLAMPS

No. 3050 No. 4050 No. 5050 No. 6050 No. 7050

Nos. 3051 & 4051 Nos. 3052 & 4052 Nos. 3053 & 4053 Nos. 3054 & 4054 No. 4055 Nos. 3057 & 4057 Nos. 3056 & 4056

SAFE • ECONOMICAL • DURABLE • NEAT

The sizes and design, except for clamps and wire knockouts, same as standard metal outlet boxes. They take standard type of fixture studs. Two clamps supplied with each box. The wire clamps hold against 125 lbs. pull. When used with fixture studs they withstand over 400 lbs. pull on stud.

These Bakelite Outlet Boxes have side knockouts and clamps to take 14-2, 14-3, and 12-2 non-metallic sheathed cable, and 14-2, 14-3, 12-2 and 12-3 CNX Type Cable and one ½ in. Bottom Knockout.

These covers are sufficiently thick to obviate breakage in installation or use. Standard color Black.

UNION INSULATING COMPANY, INC.

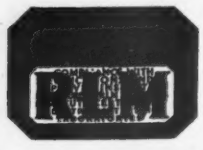
FACTORY: PARKERSBURG, W. VA.

SALES OFFICE: 27 PARK PLACE, N. Y. C.

ADJUSTABLE PORCELAIN ENAMELED FLOODLIGHT

QUAD
LIGHTING UNITS

No. 1184-M
RLM THREADED DOME REFLECTOR



● The QUAD line offers you the finest in Industrial Lighting Equipment for those important victory manufacturing installations. The demands for additional lighting in plants increases daily and QUAD units—RLM and other porcelain enameled units—will fill indoor and outdoor needs perfectly.

QUADS . . . for today and for tomorrow!

QUADRANGLE MFG. COMPANY

Mfgrs. of Incandescent and Fluorescent Lighting Equipment

32 SO. PEORIA ST. CHICAGO, ILL.

PROMINENT members of the electrical contracting fraternity at Youngstown, Ohio, (L to R) Carl Peterson, A. F. Beil and Leo J. Witt, were among those representing their city at the recent NECA conference in Chicago.

6. All splices or taps shall be soldered and covered with asbestos and friction tape, unless protected by approved insulated, solderless connectors.

7. No unnecessary splices or taps shall be made within the fixture.

8. Wires within the fixture enclosure shall be neatly arranged, not exposed to injury, run over or under the auxiliaries or resistors and all excess wiring shall be avoided.

e. Show or wall case type fixtures.—1. These fixtures are especially designed for mounting in, or on, show or wall cases.

2. Fixtures shall be installed, wired and connected in a permanent manner.

3. The use of exposed flexible cord or fixture wire shall not be employed in show or wall cases.

4. Auxiliaries, series reactors, capacitors, resistors and other control equipment, when not a part of the fixture assembly, shall be enclosed in a separate metal cabinet, provided such cabinet is suitably ventilated to insure proper dissipation of heat, installed in a permanent manner and accessible.

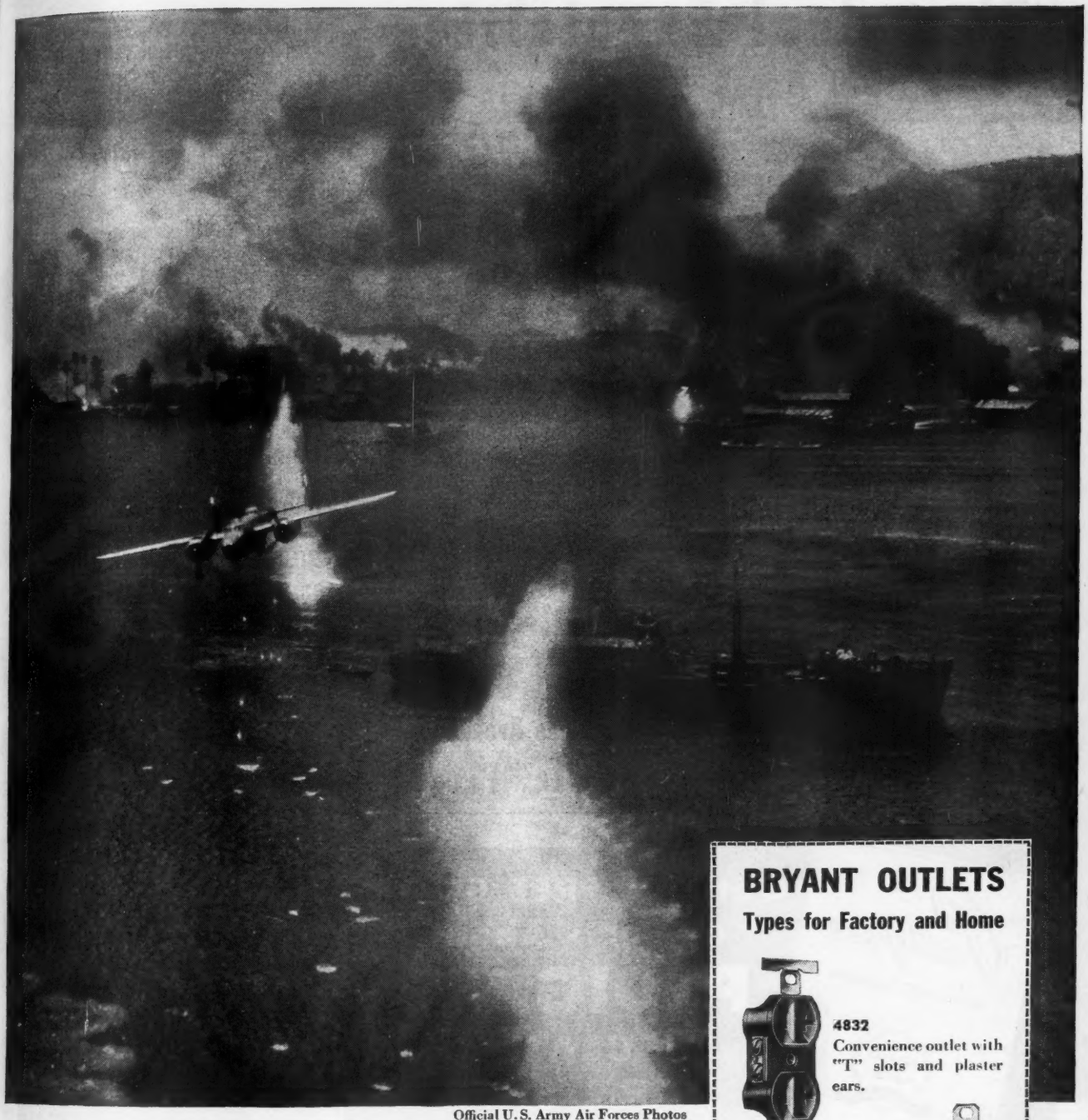
f. Control and protection of circuits.—1. Fixtures designed for operation on circuits having a potential greater than one hundred and fifty volts, shall be controlled by double pole switches and each wire of the circuit shall be provided with overcurrent protection.

PREFERENCE RATINGS FOR MRO ARE ADJUSTED

Preference ratings available to various industries for maintenance, repair and operating supplies (MRO) have been adjusted to reflect a revised pattern of relative urgency, the War Production Board has announced.

The ratings have been adjusted by means of changes in the lists of CMP Regulation No. 5. Those industries which are included in List I are eligible to use an AA-1 preference rating, and those in List II and AA-2 preference rating to obtain MRO items.

Some of the changes which are made by Amendment No. 3 to CMP Regulation No. 5, as amended September 13, 1943, are as follows:



Official U. S. Army Air Forces Photos

Major enemy base in Southwest Pacific swept practically clean by U. S. bombers. Smoke from blazing waterfront frames harbor as back drop for enemy ships sunk, sinking or burning.

★

BEFORE THIS COULD HAPPEN . . . Factories were built . . . bombs and bombers were built . . . bases were built . . . millions of men trained and equipped before this could happen! For this vastly complicated program, Bryant is producing war materials of many kinds . . . equipment used on sea, land and air . . . electrical devices for plants and bases the world over.

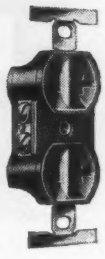
THE BRYANT ELECTRIC COMPANY

BRIDGEPORT, CONNECTICUT

NEW YORK CHICAGO SAN FRANCISCO LOS ANGELES

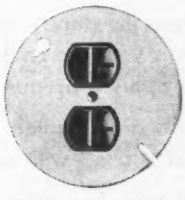
BRYANT OUTLETS

Types for Factory and Home



4832
Convenience outlet with "T" slots and plaster ears.

H142
Popularly priced convenience outlet with parallel slots.

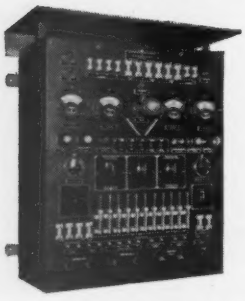


3781
Box mounting with "T" slots and 3¼ inch metal cover.

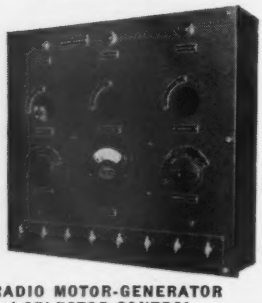
Sold through electrical wholesalers

BRYANT

Electrical Specialties
of Every Type
Including MARINE WORK



WORK TEST PANEL—built to customers' specifications and Navy standards.

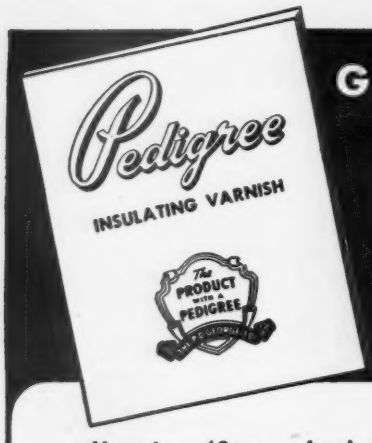


RADIO MOTOR-GENERATOR and SELECTOR CONTROL PANEL—built to customers' specifications for any number of circuits.

JMM CO

ALL types of electrical specialties, boxes, cabinets, control panels, duct-work, etc., manufactured by an organization accustomed to meeting exacting Army, Navy and Commercial specifications. Full engineering personnel and equipment for manufacture of special electrical items to customers' needs in addition to all standard articles. Let us quote you on your requirements. Write for illustrated catalog.

Jacksonville Metal Manufacturing Company
247 Riverside Avenue
Jacksonville, Florida



Get This FREE BOOK of Facts About PEDIGREE INSULATING VARNISHES

Here is a 40-page book of facts boiled down to essentials that is a help to any man who is interested in electrical insulating varnishes.

It shows you the different kinds of varnishes and why they are made. It gives you help on how to select the right varnish for your job, how to apply it properly, and the correct method of drying.

Many data are supplied in easy-to-understand tabular form. You will find it filled with useful information.

Write for your free copy today!

The PRODUCT with a PEDIGREE

***The* P. D. GEORGE CO.**
5200 North Second Street • St. Louis, Missouri

Call In the Pedigree Varnish Man Nearest You.

1. Batteries, dry cells have been removed from List II to List I, thereby making the AA-1 preference rating available to manufacturers of these products.

2. Lighting equipment and accessories for aircraft, airport and marine purposes have been moved from List II to List I, permitting manufacturers of such items to use the AA-1 preference rating. At the same time, a new listing has been included for lighting equipment and accessories other than aircraft, airport and marine, which permits the manufacturers of these products to use the AA-2 rating.

3. Use of the AA-1 rating has been limited to manufacturers of searchlights and floodlights, thus making manufacturers of spotlights and parts ineligible to use it. Formerly, manufacturers of all these products were eligible to use the AA-1 rating.

ELECTRICAL ASSOCIATION OF PHILADELPHIA SPONSORS INDUSTRIAL LIGHTING ACTIVITY

The Lighting Equipment Manufacturers Group of The Electrical Association of Philadelphia launched a Cooperative Industrial Lighting Activity at a meeting held in December. The activity will continue until April 1, 1944.

The current activity is primarily designed to aid industrial plants engaged in war work so that through adequate and proper lighting, their efforts to conserve vital materials, save man-hours and maintain continuous and increased production will be advanced. These industrial plants, in addition, will also benefit through increased plant safety and improved conditions for the health and eyesight of workers.

Cooperating in the activity are fifteen companies manufacturing industrial lighting equipment and their jobbers; also eighteen electrical contractor companies and the utility company.

***TRI-STATE TRIO** of electrical construction men is composed of (L to R) Bancroft Foley, H. P. Foley Co., Washington, D. C.; Al Kahn, Monroe Electric Co., Chicago; and H. H. Hudson, IBEW business manager, Louisville, Kentucky.*

How to Select

INSULATING TAPES

Keep these facts in mind when selecting insulating tape:

A. The base cloth must: (1) have ample mechanical strength; (2) be chemically inert: (3) contain minimum sizing to permit thorough penetration by the insulating varnish and prevent weakening of the fiber in service.

B. The varnish must: (1) be neutral in relation to the cloth; (2) impart maximum dielectric strength, flexibility and resistance to heat, oil, water or other damaging agents against which the particular tape is to give protection.

C. A ready source of supply for all types of insulating tapes must be available. Your local G-E distributor handles a complete line of tapes, as well as all other insulating materials, and can furnish detailed data and catalog on request. Or send for catalog to Section M243-8, Resin and Insulation Materials Division, General Electric Company, Schenectady, N. Y.

GENERAL ELECTRIC

WATER ON DECK
REQUIRES
MOTOR CONTROLS

So important are the requirements for fluids aboard ship that only the most dependable controls are used in the regulating and pumping systems.

Ward Leonard motor starters are furnished in great numbers for use on war craft and merchant men. They are Ward Leonard designs that meet navy requirements.

Users of motor starters for marine and other purposes will find in the Ward Leonard Line exactly the equipment to best do the required job. The dependability that is the first consideration for nautical use is desirable in all other types of endeavor.

Send for data sheets and bulletins describing Ward Leonard Motor Starters and other control devices.

WARD LEONARD

RELAYS • RESISTORS • RHEOSTATS

Electric control (WL) devices since 1892.

WARD LEONARD ELECTRIC CO., 28 South St., Mt. Vernon, New York

ELECTRICITY
For Any Job Anywhere

Awarded to each of ONAN's four manufacturing plants.

ONAN GASOLINE DRIVEN ELECTRIC GENERATING PLANTS provide power and light wherever electricity is not otherwise available and for emergency Services.

Thousands of these reliable, sturdy Plants are doing war winning work on all fighting fronts.

Sizes from 350 to 35,000 watts, 50 to 800 cycles, 110 to 660 volts, A.C.—6 to 4000 volts, D.C. Also A.C.-D.C. output models available.

Your inquiry regarding present or post war needs will receive prompt attention.

D. W. ONAN & SONS
2086 Royalston Ave.
Minneapolis, Minn.

ONAN
ELECTRIC PLANTS

There will be attractive awards of war bonds and money for jobbers salesmen and utility company salesmen; also a trophy for the wholesale organization achieving the highest point record per salesman registered.

Running concurrently with the Industrial Lighting Activity, from January 18, until April 4, 1944, will be an "Elementary and Refresher Course" of lessons in practical illumination.

This educational activity is being sponsored jointly by the Lighting Equipment Manufacturers Group and the Philadelphia Section, Illuminating Engineering Society.

Sessions of the course will be held on Tuesday evenings and will continue for twelve consecutive weeks. The meetings will be held in the auditorium of the Edison Building, 9th and Sansom Streets, and are scheduled to begin at 7 P. M., concluding at 8:30 P. M.

Those eligible to enroll in the course are men directly or indirectly interested in lighting.

PR NO. 13 REVISED

Priorities Regulation No. 13, governing special sales of idle and excess materials, has been revised, in order that all regulations issued prior to December 22, shall have no effect on redistribution of such materials, the War Production Board has announced.

The only exceptions to this general rule are Directive No. 16, governing aircraft inventory transfers and Order P-98-c, governing special sales in the petroleum industry.

To find the rules governing a special sale of idle or excess materials, there is no need to refer to any order or Regulation other than Priorities Regulation No. 13, outside of the two stated exceptions.

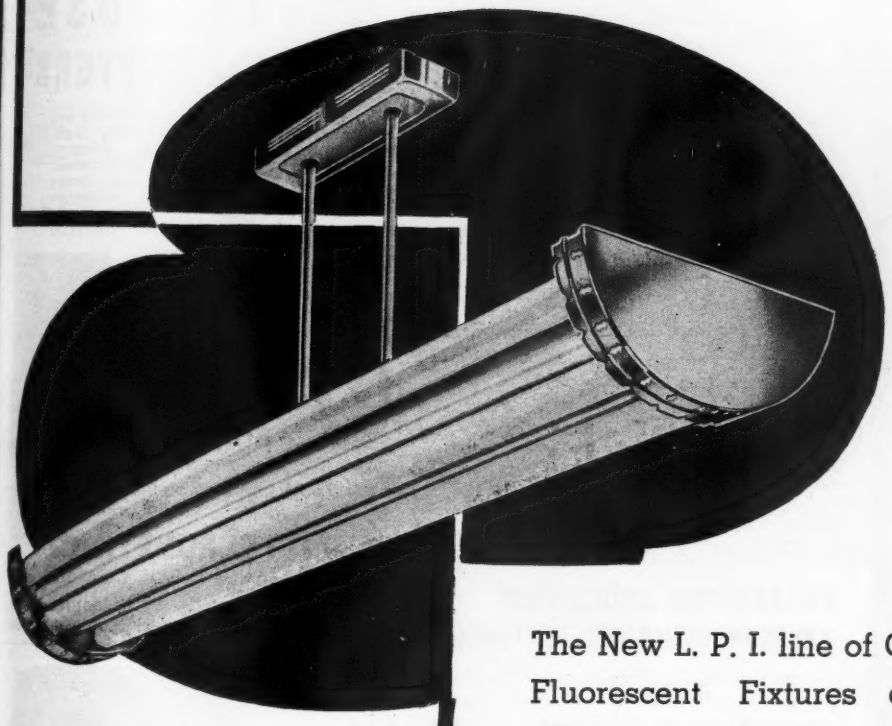
However, it is pointed out that orders issued after December 22, which may specially indicate that Priorities Regulation No. 13 has no effect shall govern special sales of items which they may cover.

In the case of copper or copper base alloy, such permission may be granted

IT MIGHT have been beer that made Milwaukee famous, but its contractors like Wm. R. Sorgel (left), Sorgel Electric Co., and J. J. Beyer, Uihlein Electric Co., that strengthen its electrical construction industry.

AN L.P.I. COMMERCIAL FLUORESCENT

for every Essential Purpose!

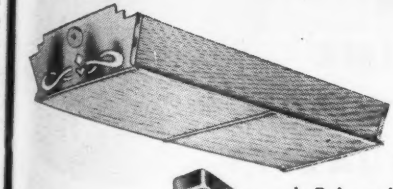


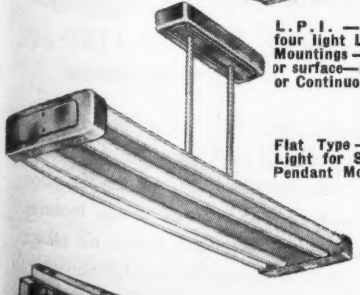
FURNISHED WITH EITHER INSTA-START OR CONVENTIONAL BALLASTS...

The New L. P. I. line of Commercial and Industrial Fluorescent Fixtures combines high lighting efficiency with ultra smart appearance and is fabricated to the most exacting standards.

Designed to speed up installation L. P. I. fixtures not only cut installation cost because they do not have to be opened for hanging, but also reduce maintenance to a minimum where Insta-Start Ballasts are used due to starter switch elimination. Then too, Insta-Start Fixtures not only start and operate at zero temperatures but also will start as fast as an incandescent lamp on as low as 85 volts where line load is a factor.

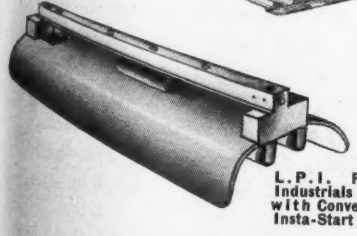
Write or wire today for complete information on this new Fluorescent line.





L.P.I. — U.R.C. four light Luminaire. Mountings — Pendant or surface—Individual or Continuous.

Flat Type — 2 or 4 Light for Surface or Pendant Mounting.



L.P.I. Fluorescent Industrials furnished with Conventional or Insta-Start Ballasts.

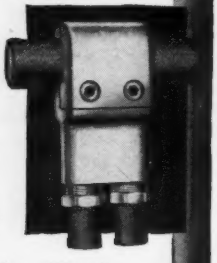
LIGHTING PRODUCTS, INC.

HIGHLAND PARK, ILLINOIS

"You have ALL Types of Tees to choose from—

—in the COMPLETE line"

All in one catalog, for your handy selection—*every* good type of tee connector... Each one carefully designed and tested, and manufactured under rigid engineering supervision.



Penn-Union Type HFM, with one-bolt or 2-bolt hinged clamp for the main. One or more branches can be connected afterward. Multi-slit tapered sleeve assures permanent grip on branch.

Penn-Union Hinged E-Z Tee takes a wide range of branch sizes. One-piece design makes installation easy. Tap connections can be made at any time.

Clamp Type Tees for all sizes of tubing and cable—a complete line. Machined contact surfaces.

Types for All Combinations—for connecting flat bar, run or tap, to tubing or cable. Also "general utility" tees that take a wide range of conductor sizes.

Penn-Union E-Z Tee is ideal for accommodating a large range of conductor sizes on both the main and branch. Will not loosen. 2, 3 or 4-post.

Penn-Union fittings are preferred by utilities, industrials, electrical manufacturers, contractors—because they have found that *Penn-Union on a fitting is their best guarantee of Dependability.*

PENN-UNION ELECTRIC CORPORATION

ERIE, PA. *Sold by Leading Jobbers*

PENN-UNION

Conductor Fittings

by the Regional offices only if the buyer has an allotment and an authorized production schedule for the product which he intends to manufacture from the excess or idle materials which he will acquire.

RULES FOR PR NO. 3 MODIFIED

The War Production Board has announced that rules applicable to the operation of the Priorities System, as covered in Priorities Regulation No. 3, have been modified.

The amended version prohibits persons who supply materials appearing on List B of the Regulation for shipboard use on blanket MRO preference ratings from extending the ratings which have been applied to them.

List B is amended to permit the use of blanket MRO ratings of AA-2 or higher for the purchase of fluorescent lighting fixtures as defined in Limitation Order L-78 and incandescent lighting fixtures as defined in Limitation Order L-212, and electric floodlights.

The amended Regulation also indicates that Lists A and B will be revised on or about the 15th of every other month. The next revision of the lists will be issued about the 15th of February.

PHILADELPHIA ASSOCIATION SPONSORS COURSE ON ELECTRONICS

The Contractors Division of The Electrical Association of Philadelphia is sponsoring a lecture course for journeymen electricians and electricians' helpers on the subject of "Electronics".

The course, which started Wednesday evening, January 5th, includes two series of lectures. Series One will conclude on

ROY W. ROBINSON of Robinson Electric Co. Inc., Charlotte, N. C., specializes in lighting engineering and contracting. He and his company are already preparing an industrial and commercial lighting campaign to open up when fixtures and wiring material again become available.

TROUBLE FINDERS that save CONTRACTORS TIME!

Vest-pocket help that speedily locates trouble or tells performance is *dependably* provided in

LITTELFUSE

***Tattelite* TESTERS**

Neon lamp tells the tale. Here are instant reporters on shorts, leakages, current output, polarity, blown fuses, defective spark plugs, cables, condensers, and many other conditions that otherwise would require tedious search. To right: No. 5076, 60 to 500 volts $1.00 ea.

Low Voltage Tattelites $1.75 ea.

No. 5370, 3 to 25 v.

No. 5420, 6 to 50 v.

Momentary contacts 50 to 80 v.

Folders give complete description. Write

LITTELFUSE INC.

4789 Ravenswood Ave., Chicago 40, Ill.

259 Ong St., El Monte, Calif.

TOPS IN TIME SWITCH QUALITY

for only $13.00 LIST...

The Paragon 300 Series includes ALL the essential features of truly top quality time switches . . . yet the list price is only $13.00. Some of the features are: only 2 exposed gears, all others operate in a sealed oil-filled chamber; slow speed motor; sturdy clock train; snap-action switch; simple hand trip; attractive modern case; 2000% more dial power than required. Satisfactory service, workmanship and material guaranteed. Send for complete bulletin.

PARAGON ELECTRIC COMPANY

401 So. Dearborn St. Chicago, Ill.

Paragon *Chicago*

BUILDERS OF ELECTRICAL EQUIPMENT . . . . SINCE 1901

April 12, 1944, while the second series begins December 6, 1944 and concludes March 13, 1945. The lectures will be held at two week intervals on Wednesday evening from 8 P. M. to 10 P. M.

The course was prepared by a committee representing the Contractors Division and Dr. S. Reid Warren, Jr. of the Moore School of Electrical Engineering, U. of P. All of the lectures will be presented by members of the Moore School staff and will be held in the headquarters of The Electrical Association of Philadelphia, Architects Building, 17th and Sansom Streets.

Howard L. Miller, Chairman of the Contractors Division and President of the Electrical Association, states that the enthusiastic reception given this course by journeymen electricians and their helpers is evidence of the widespread interest in the subject.

BLANKET MRO RATINGS FOR EXISTING INTERCOMMUNICATING SYSTEMS

Blanket MRO (maintenance, repair and operating supplies) rating may be used to add stations to an existing wire intercommunicating system to bring it to its designed capacity, the War Production Board has announced. An intraplant telephone system would be an example of such a wire intercommunicating system.

Thus, if an intercommunicating system is designed for 16 stations, and only 12 stations have been installed, four stations may be added by use of blanket MRO ratings. However, any expansion beyond the 16 stations, or any enlargement of the designed capacity or any expansion of it, may not be obtained by use of blanket MRO ratings, since use of these ratings for obtaining electronic intercommunicating systems or wire systems is prohibited under Priorities Regulation No. 3.

The ruling was given in Interpretation No. 8 to Priorities Regulation No. 3.

WPB pointed out that signal and alarm equipment is generally installed without a specific margin of unused designed capacity and therefore no additions or extensions by use of blanket MRO rat-

CHUMMY GROUP of Kansas City, Mo., electrical contractors includes (L to R) John Murray, A. M. Burnett, W. T. McAuley, A. E. Smiley and William Wachter.

"We've had our Greenlee 5 years — it saves us 15% in man hours and cuts material spoilage 25%," says Lyle Foster, Foster Electric Co., Peoria, Ill. The above photo, taken in the Foster shop, shows how one man easily operates the powerful hydraulic bender, developing *40 tons pressure,* for bending up to 4½-inch pipe.

Whatever your bending job — all types of tubing, thin and heavy-wall conduit, copper or standard pipe — there's a Greenlee Bender to do it better and faster . . . with smooth, accurate, uniform bends. Greenlee Benders are light, compact, easily-carried. Get the facts now by writing for free Bender Booklet below.

Get Ready with Greenlee!

REGISTERED TOOLS

GREENLEE

FOR THE CRAFTSMAN

SEND FOR *Free* BENDER BOOKLET NO. S-116

How can a Greenlee Bender save time and material for you? Get the answer in this free book. Write Greenlee Tool Co., 1742 Columbia Avenue, Rockford, Illinois.

VICTORY LINE

Comprises 28 types of electrolytic capacitors for 110-volt operation; 6 types for 220-volt.

These 30 universal types can take care of upwards of 90% of all motor-starting capacitor replacements.

Handy Aerovox conversion chart indicates Victory equivalent for any previously available type.

● **Yes, it's profitable to service those motor-starting capacitors of electric refrigerators these days, making use of the Aerovox Victory Line. You can keep those refrigerators running for the duration. You can keep those customers satisfied. And you can make a nice profit.**

• Ask Our Jobber . . .

Ask him about these Aerovox Victory Line capacitor replacements. Ask to see the conversion chart so you can pick the right wartime replacements. Or write direct.

AEROVOX Capacitors
INDIVIDUALLY TESTED

AEROVOX CORP., NEW BEDFORD, MASS., U. S. A.
In Canada: AEROVOX CANADA LTD., HAMILTON, ONT.
Export: 100 VARICK ST., N. Y. C. • Cable: 'ARLAB'

COMING MEETINGS

North Central Electrical Industries—Second Electrical Industry War Conference, St. Paul Hotel, St. Paul, Minnesota, March 26-28 inclusive.

National Electrical Wholesalers Association—Second Annual War Conference, Stevens Hotel, Chicago, Ill., April 19-22.

National Electrical Manufacturers Ass'n.—Spring Meeting, Palmer House, Chicago, Ill., April 24-27.

National Fire Protection Ass'n.—Annual Meeting, Benjamin Franklin Hotel, Philadelphia, Pa., May 8-11.

American Institute of Electrical Engineers—Summer Technical Meeting, Jefferson Hotel, St. Louis, Mo., June 26-30.

NEW P.U. COMMITTEE FORMED TO AID UNRRA

Formation of a Public Utilities Committee has been announced by the Combined Production and Resources Board to "assemble all pertinent facts and recommend such action as may be advisable concerning requirements, supplies and production of equipment to re-establish electric, gas and water services in the liberated and former enemy areas which may be required during the relief period."

It was agreed at the Atlantic City meeting of United Nations Relief and Rehabilitation Administration that the requirements of liberated areas put forward by UNRRA would be referred to the Combined Boards for consideration in relation to other military or civilian claims for the same supplies. It will be for the Combined Boards to make recommendations on how far the requirements put forward by UNRRA can be met.

The Chairman of the Committee and American member will be J. A. Krug, Director of the Office of War Utilities, WPB. The member for Great Britain will be Sir Henry Self, Deputy United Kingdom Member of CPRB; the member for Canada will be Dr. T. H. Hogg, Chairman of the Hydro Electric Power Commission of Ontario.

The Committee is expected to survey requirements and the availability of utility equipment and to decide, in conjunction with other operating organizations of the three governments, on any necessary production programs for equipment to meet basic utility needs in liberated and former enemy areas.

Book Reviews

A PRIMER OF ELECTRONICS

One of America's foremost engineers said recently that "electronics is not a dream of tomorrow, but an accomplishment of today". Electronics is a comparatively young science having been exploited only over the past 20 years. Industrially, commercially and domestically electronic equipment holds forth great prospects.

In order to give a more fundamental understanding of this new science to the ordinary laymen from the housewife to the manufacturing executive, a Primer of Electronics has been written by a Sylvania Electric Products commercial engineer, Don P. Caverly. The text is concise and written in a language free of all technical complexities. Yet, in view of the author's background, it is authoritative and complete. The book takes the reader step by step from the atom and the electron through electric current, magnetism and electro magnetic radiation to an understanding of simple radio tubes, fluorescent lamps, cathode ray tubes, ignitron, thyratron, and other tubes and their basic connections for practical purposes. Over 200 specially prepared illustrations are an important factor in the clarity of the treatment.

The book—A Primer of Electronics by Don P. Caverly and published by McGraw-Hill Book Co., Inc., New York, N. Y., $2.00

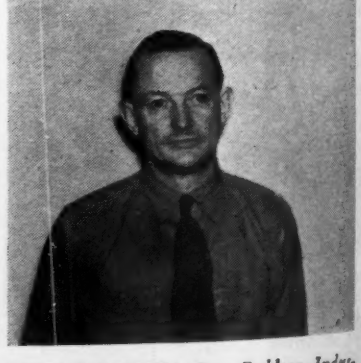
SUCCESSFUL SOLDERING

The process of soldering is used perhaps more often and in more kinds of trades and crafts than any other simple method of joining metals, and yet it is often performed incorrectly. In the preparation of this book an attempt has been made to treat the subject in a clear, concise, understandable manner and to give the necessary directions and instructions so that the least experienced person can learn to solder. It is definitely a "how-to" book. Many illustrations provide the reader with visual explanations.

The data given will also aid the experienced workman in choosing the right materials and methods for any special soldering work he may encounter.

The book covers the fundamentals of the process, and then takes up in detail the various types of solders, showing the purpose and correct uses of each. It then covers the special problems of soldering various metals such as black iron, zinc, tin, stainless steel, copper, aluminum, pewter, brittania metal, and lead, devoting a separate chapter to each.

The book—Successful Soldering by Louis S. Taylor published by McGraw-Hill Book Co., Inc., New York, N. Y., $1.00.



NISA BOOSTER, Otto Pohlers, Industrial Electric Service Co., Joliet, Ill., makes regular trips to Chicago to attend motor shop organization meetings.

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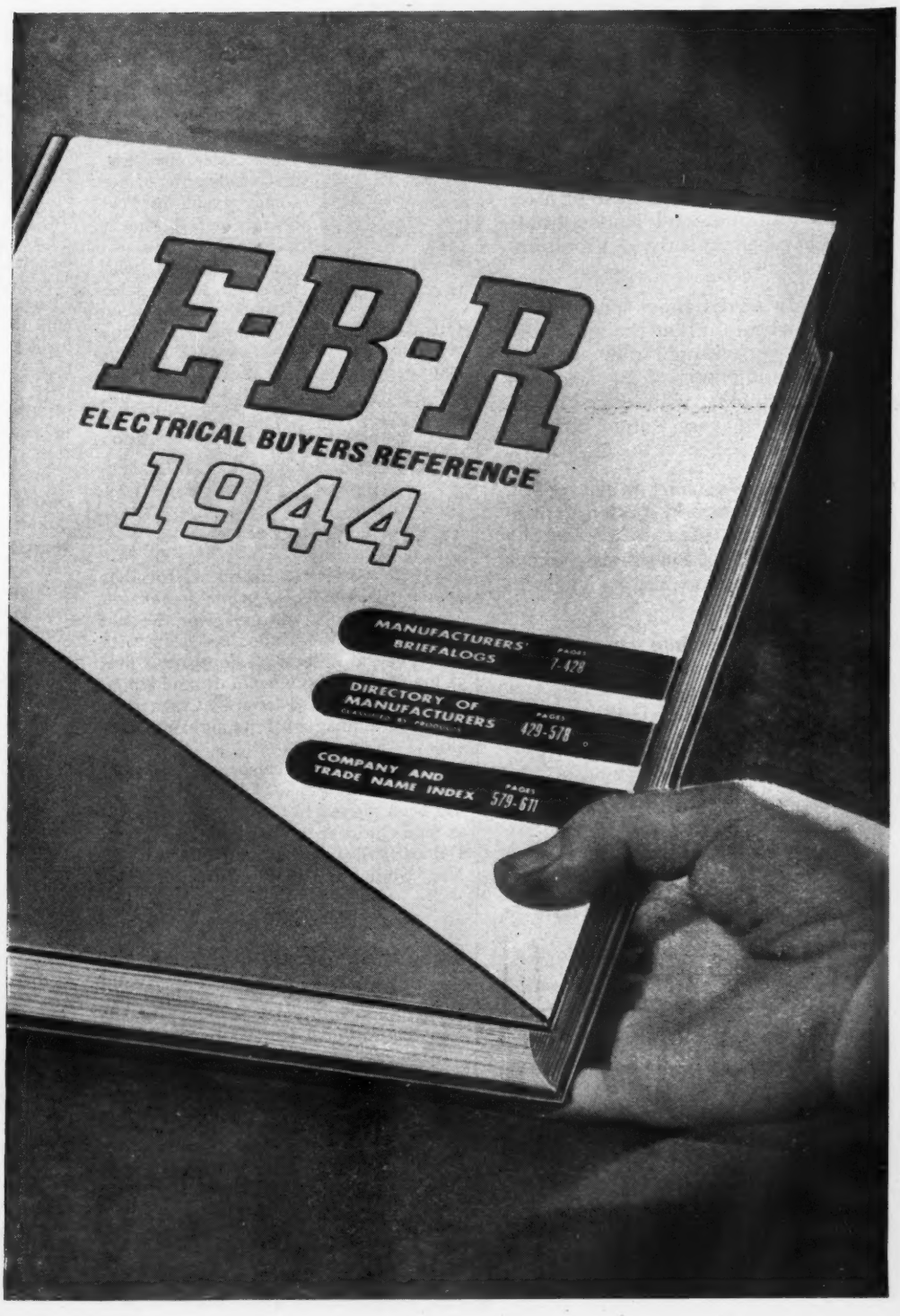

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MANUFACTURERS NEWS

THOMAS & BETTS CHANGES

Adnah McMurtrie, vice-president, director and one of the original founders of the Thomas & Betts Company, Elizabeth, N. J., has retired after 50 years in the electrical industry. He will continue to serve the company in the capacity of a director.

N. J. MacDonald has been made vice-president of the company. He joined the Thomas & Betts Co. in 1921 and in 1929 was elevated to the position of sales manager. Six years later he was made a director of the company and in 1940 became vice-president in charge of sales.

MAC DONALD

E. C. Hewitt, who has been acting sales manager has been named sales manager. He joined the company in 1929 and in 1937 became manager of the New York City office and District manager of the New York and Connecticut territory. In 1941 he went to the Elizabeth factory as acting sales manager.

•

SYLVANIA CHANGES

Sylvania Electric Products, Inc. has appointed Fred Fulle product manager of cold cathode lighting. For the last three years, Mr. Fulle has been with the Federal Electric Company, first as manager of the New York and Philadelphia offices and later in Chicago as assistant manager of its lighting division.

Ben Kievit, supervisor of Customer Services of Sylvania in Emporium, Pa., has been moved to the New York office as field engineer in the Equipment Sales Department for the metropolitan and New England area.

•

WESTINGHOUSE CHANGES

William J. Massey has been appointed general lamp sales manager of the Westinghouse Lamp Division with headquarters at Bloomfield, N. J. He will have charge of all lamp sales activities of the Lamp Division including district sales offices: the illuminating engineering, commercial engineering and advertising departments.

The appointment of James H. Jewell as assistant manager of Industry Departments was announced by the Westinghouse Electric and Manufacturing Company. Mr. Jewell, manager of the Company's Agency and Specialties Department since 1940, will continue to head that division.

MASSEY

JEWELL

Leon R. Ludwig, formerly head of the Westinghouse Circuit Breaker and Protective Devices Division, has been named manager of the Motor Division. He succeeds R. W. Owens, who has resigned.

•

G-E APPOINTMENTS

Fred G. Stebbins has been appointed manager of sales, capacitor section and Edward V. Dillon assistant manager of sales, feeder voltage regulators, in the Transformer Division of the Central Station Divisions, General Electric Co. Mr. Stebbins succeeds Charles F. Miller who will be senior transformer specialist for the New York District. Mr. Dillon's position has just been created in this section of G. E.

STEBBINS

W. M. Stearns, manager of trade relations and special contracts, has retired after 39 years of service with G-E. He will be succeeded by W. A. Sredenschek, who for the past three years has been assistant manager of trade relations and special contracts.

E. A. Green has been named general assistant to the manager of G-E's motor division.

•

Russell L. Test has joined the sales department of the **Phoenix Glass Company** with headquarters at Monaca, Pa. His principal duties will be in promotional development work, primarily for post-war planning. Mr. Test was formerly manager of the Lighting Division of the Corning Glass Works.

•

Triangle Conduit & Cable Co., Inc. New Brunswick, N. J. announces the appointment of C. V. McKay as assistant to the president. For the past 20 months he has been with the War Production Board at Washington as assistant chief Wire Mill Branch, Copper Division.

•

Littlefuse, Incorporated of El Monte, California and Chicago, Ill. has appointed William A. Foote to be sales coordinator.

Russell & Stoll, Inc., New York, has elected F. L. Novak vice-president. He became associated with the company as assistant to the president in 1927, devoting the first 10 years to engineering and manufacturing duties. In recent years, he has devoted his time to the coordination of these functions with the sales and personnel activities.

NOVAK

Mr. Novak is also president of the Feedrail Corporation, a Russell & Stoll affiliate.

•

Reeves Sound Laboratories, New York City, announces the appointment of William C. Speed as vice-president in charge of manufacturing. He is also a director of the company.

•

Oliver Iron and Steel Corporation, Pittsburgh has named Bennett W. Johnson as general manager of sales of the Pole Line Hardware Division.

•

Ray Murphy has established his own business on the West Coast as manufacturers' representative for Crescent Insulated Wire and Cable Company, Trenton, N. J., Spang-Chalfant, and Steel City Electric Company, both of Pittsburgh, Pa. Mr. Murphy's office and warehouse is located at 720 East Second Street, Los Angles, Calif.

T. K. PREDDY, manager of Electric Motor and Repair Company in Richmond, Va., is carrying on successfully in the absence of the owner, Lt. J. W. Overton, Jr., commissioned officer in the United States Naval Reserve and stationed with the Westinghouse Electric and Manufacturing Co. in East Pittsburgh, Pa.

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Motor Shops

[FROM PAGE 61]

flat on a bench, with the side or surface of the coils that bear against the frame when in the motor, laid against the surface of the bench, i.e., with the armature side up.

Fig. 1 indicates that all the field coils have the leads on the commutator end, all are alike, i.e., open coils, the coils are counter clockwise, and the main field coils have a taper on the armature side.

The information shown in Fig. 1 illustrates that to wind the field coils for this motor, we must know how to convert such data into winding and assembling data for the required coils. In fact, there are many cases where only the coils are shown in Fig 1A without the connections between coils; then we must make coils with leads arranged to make the simplest wiring-around-frame connections.

Starting and Finishing Leads—Any field coil will have two leads. For identification and standardization purposes these can be called the starting or inner lead and the finishing or outer lead. The starting or inner lead is always the

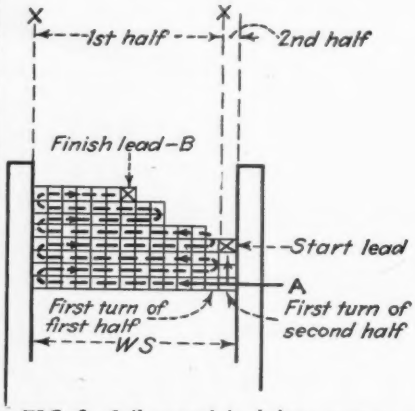

FIG. 2. Coil wound in halves, start on right, taper on right, starting lead on armature side. Counter clockwise. Open coil.

start of the first turn of the first layer, or the lead from the innermost section of the coil, as at A Fig 2. The finishing or outer lead B Fig. 2 is always the end of the last turn of the last layer or the lead from the outermost section.

Starting the Coil Winding—There are two methods employed in starting the winding of wire-wound field coils. These are (a) start-on-right, (b) start-on-left. The start-on-right method is used to a greater extent than start-on-left and may be considered as standard.

Start-on-Right Coils—Begin with the field-coil mold fastened to the face plate of a winding head and with the operator standing facing the machine and mold. Then, with the mold arranged to revolve clockwise, i.e., away from the observer, the wire is fastened to the right-hand side of the mold as at A Fig. 2. With the wire fastened in this manner and the mold rotating clockwise, the wire will be drawn over the top of the mold.

With the start-on-right coils, they may be either clockwise or counter clockwise; thus they can be made of north or south magnetic polarity, all depending upon how the starting-lead side is placed.

If the starting-lead is placed on the armature side the coil will be counter

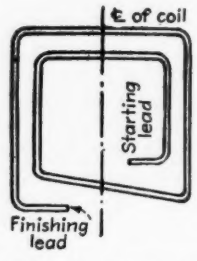

FIG. 3. Open-coil starting or finishing leads not brought up to, nor past, center-line of the coil.

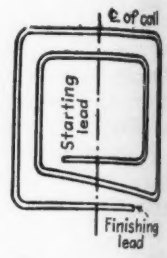

FIG. 4. (right) Crossed-coil starting and finishing leads of coil brought past center-line of coil.

clockwise, and if on the frame side it would result in a clockwise coil, as will be shown later.

An easy way to check the various sketches and statements regarding start-on-right or left, etc., is to use round solder wire and make small coils of a few turns to illustrate the different terms as they are discussed.

The start-on-right coil is preferred, as the starting wire or free end, can be held or fastened to the mold more readily The start-on-right coil when laid on a bench with the starting lead up, represents a left-hand screw thread.

The major items of information needed for the correct interpretation of field connecting diagrams must be incorporated in the winding of series field coils, and are: (a) how wound; straight up or in halves. (b) how started; on right or left. (c) how many turns. (d) how many layers. (e) how tapered. (f) size of wire, kind of insulation on wire. (g) how crossovers are arranged; whether concentrated on one end or distributed, and (h) size of mold, that is width, length, wire space, radius on corners, etc.

The coil shown in Fig. 2 is wound in halves up, start-on-right, taper-on-right, and there are eight layers. Four layers are full, of 16 turns each followed by one layer of 14 turns. The check mark indicates that one turn in this fifth layer is dropped from the right-hand side of the mold. In other words the coil tapers on right. The sixth layer has 12 turns tapered on right; the seventh, has 10 turns, tap-

ered on right; the eighth or last layer has eight turns tapered on right.

The left side of Fig. 2 between lines x-x indicates the number of turns in winding the first half of the coil. It shows 60 turns for the first four full layers, 14 for the next layer, and so on until a total of 104 is shown for the eight layers. Then the data for the second half shows four layers of 1 turn each at right of mold to starting lead, making a total of 108 turns for the coil.

The data in Fig. 2 calls for open coils. However, the starting lead of the coil will be brought well beyond the centerline of the coil. It is general practice with wire coils, to bring the starting and finishing leads well past the centerline of the coil. This enables the motor assembly men to make open or crossed coils, or to attach flexible cable leads in a manner that permits secure anchorage.

The terms "open", "crossed", "right-hand coils", "left-hand coils" referred to at the start of this material is defined as follows:

An open coil is one in which the starting lead or finishing lead is not brought past the centerline of the field coil. An open coil is shown diagrammatically in Fig. 3 where both the starting and finishing leads are shown as stopping short of the centerline. The leads do not cross or pass each other.

A crossed coil is one in which the starting and finishing leads are brought beyond the centerline of the field coil. A crossed coil is shown diagrammatically in Fig. 4. The starting lead has been brought beyond the centerline to the left-hand side of the coil, while the finishing lead has also been brought beyond the centerline, to the right-hand side of the coil.

The terms open and crossed are applied only to coils that have both the starting and finishing leads brought out on the same end of the coil, that is, both leads are either on the commutator or on the pinion end of the coil. This means that the jumper cables, etc., are also all on one end.

In some cases it is desirable to have the connections between field coils, on both ends of the frame, which means that the field coils will require leads on each end. This brings up the terms, right- and left-hand coils.

A left-hand coil can be defined as one wherein one lead is brought out from each end of the coil. Regardless of which end the coil is viewed from, the lead on *that* end points to the left, away from the centerline of the coil.

A right-hand coil can be defined as one wherein one lead is brought out from each end of the coil. Regardless of which end the coil is viewed from,

[Continued on page 136]

Silv-A-King "RLM" Standard Dome Reflectors

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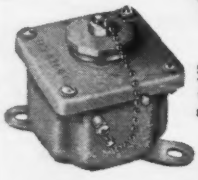

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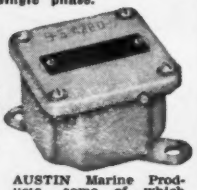

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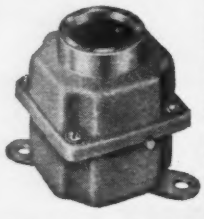

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Motor Shops

[FROM PAGE 135]

the lead on *that* end points to the right, away from the centerline of the coil.

Thus by using right- and left-hand coils in a frame with coil connections on both the commutator and pinion ends, the same effect is obtained as with open and crossed coils with connections all on one end.

The next article will continue the discussion on winding coils.

SLEEVING RACK ON COIL WINDER

Many steps are saved in the motor shop of Best Electric Company, New Orleans, by having the sleeving for coil ends handy right at the coil winding head, instead of taking the wound coils to another bench, cutting the sleeving and placing it over the ends.

To accomplish this, a simple rack, made of No. 14 gage sheet steel, is welded to the top of the winding head gear enclosure where it is easily accessible to the winder. The rack, divided into four equal sections, is 15½-inches wide, 9½ inches high and deep enough to accommodate a pre-determined quantity with those sleeves of different diameters stacked in different sections.

Sleeves are cut to the proper length in bunches and used to replace the stock in the rack as it diminishes. Now the winder can just reach over, select the necessary lengths of sleeves, and place them over the coil ends before he removes the coil from the winding head.

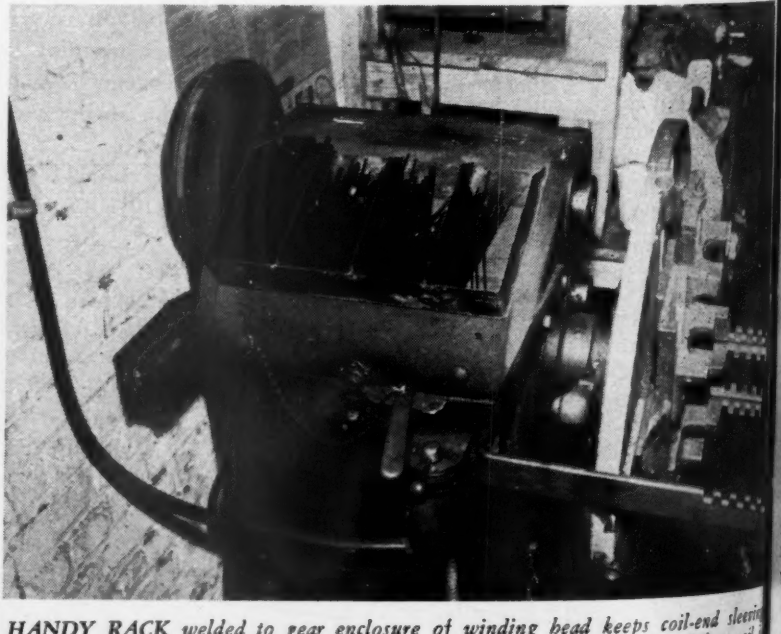
Practical Methods

[FROM PAGE 50]

reality, this system is a combination of three individual booth units with a single exhaust fan.

In designing the above system, the cfm. capacity was based on manufacturers' recommendations. If, as in this case, the separate units are grouped into a single system, the total capacity is determined by adding up the cfm. requirements of the individual booths plus allowances for resistance and the discharge method—open air.

***FLEXIBLE CONNECTIONS** permit swinging the exhaust duct arm in either horizontal or vertical direction to serve the welder on any type of work in any part of the booth.*



***HANDY RACK** welded to gear enclosure of winding head keeps coil-end sleeving within reach of winder's hands. Sleeves can be placed over coil ends before coil is removed from head.*

dust arrester, or whatever other means is employed.

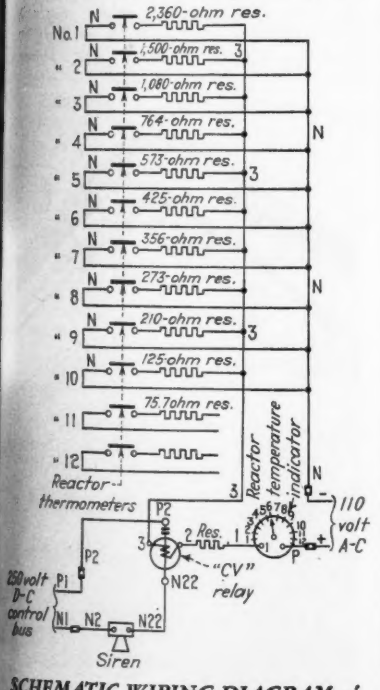
In addition to safeguarding the health of the welders, this exhaust system materially reduces the maintenance problem in the plant. By exhausting the flux fumes at the arc, deposits no longer appear on the building floors, walls and ceilings, lighting fixtures and other equipment. The net result is a lower total over-all maintenance cost, better seeing conditions and a cleaner atmosphere in which to work.

SIGNAL CIRCUITS

INDUSTRIAL

Signal circuits can be employed to advantage in many places on the industrial front. Electrical devices can be used as silent sentinels to release men in attendance duties for more productive work. To cite a concrete example, the current limiting reactors at a Carnegie-Illinois Steel Corporation plant no longer require constant attendance.

Their former practice was to keep a man continually making rounds, check-



SCHEMATIC WIRING DIAGRAM of the signal circuit which not only notifies an attendant that trouble has occurred, but also indicates where the operator can locate the trouble.

ing reactor temperatures. Each reactor is equipped with an indicating thermometer and the purpose was to protect against deterioration resulting from operation at too high temperatures.

[Continued on page 138]

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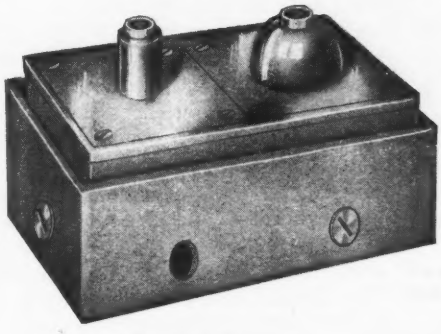

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Practical Methods

[FROM PAGE 137]

Then one of the workmen advanced the suggestion of signal circuits through the C-I Improvement Record System whereby simplification of maintenance procedures are encouraged. Consequently, each reactor was equipped with a thermal element which would operate at a predetermined temperature value. A 110 volt a.c. signal circuit was run, paralleling all twelve reactor thermal switches. Resistances, each of a different value, were inserted in series with the thermal switches so that a dial indicator, with a pointer and face numbering up to 12, would indicate the hot reactor upon a signal from the particular thermal switch.

For example, referring to the wiring diagram, take No. 7 reactor to No. 2 substation. A resistance of 356 ohms is inserted in the paralleled indicator circuit. When the thermal switch closes because of too high temperature in the No. 7 reactor winding, the indicator pointer comes to rest at the number "7". The current of 0.31 amperes

$$(I = \frac{E}{R} = \frac{110}{356} = 0.31 \text{ amp. approx.})$$

is only sufficient to turn the pointer to number 7.

The indicator operates on a damped meter principle (more current, more torsional force, and vice versa), with the resistance inserted in each circuit, predetermined and calibrated with the indicator for correct indication.

Simultaneous with indicator operation, a relay operates energizing a siren connected to the 250 volt d.c. powerhouse control bus, and calls attention to the existence of a faulty condition. The siren remains in operation until the thermal switch is reset at the reactor. The cause must be immediately removed by switching or other means to reduce the heating, or the switch will snap back into the closed position, re-energizing the siren.

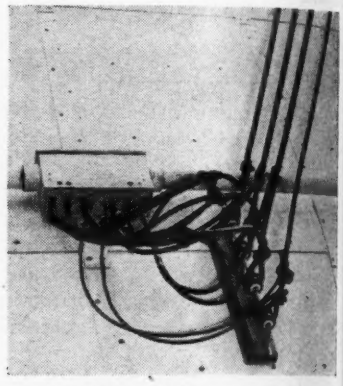
Such a multiple signal system can be as elaborate or simple as desired, and can be modified to meet practically any type of operating condition. Assurance of normal flow of fluids can be had by a similar system utilizing pressure switches. In combination with single contact simple relays, a signal circuit can be utilized to "notify" the proper authority when essential conveyors, fans, blowers, furnaces, machines, or any type of industrial equipment fails to operate properly. The signal circuit can also be utilized to disconnect the load from the line.

TRANSITE JUNCTION BOXES

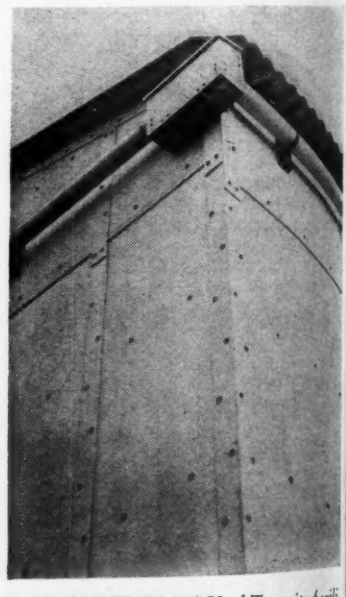
WIRING

To eliminate the use of critical materials as much as possible, Transite ducts and junction boxes were used wherever practicable on electrical circuits at the Oak Ordnance Plant in Illinois. Outdoor distribution circuits in Transite ducts encircle the machine shop and maintenance department building to serve standard power and lighting cabinets in this non-hazardous area.

Entrance to this duct loop is made through a weatherproof Transite connection box with holes drilled in the bottom to accommodate the multiple cables connected to the overhead service from a nearby pole mounted transformer station. An ordinary four-spool house bracket is used to dead-end the three-phase, four-wire, service con-



ENTRANCE BOX, *constructed of transite, accommodates service conductors for this ordnance plant machine shop. Transite duct encircles building to feed numerous lighting and power panels inside.*



CORNER PULL BOX *of Transite facilitates installation of cables in this Transite duct line. Similar units are inserted in the line wherever taps are made to feed panels inside the building.*

ductors at the building. Transite duct, mounted by two hole straps to wood block supports, branches out in both directions from the entrance box to encircle the building.

At the building corners, similar boxes were used as pull boxes with one duct line entering the side and continuing out the back and along the length of the structure. The same type of box was inserted in the duct line wherever a tap-off was made to feed an indoor lighting or power panel. All boxes are constructed with removable covers to facilitate cable pulling and splicing or connections.

Modern Lighting

[FROM PAGE 94]

LIGHT FOR WELDING OPERATIONS

Light conditioning for electric welding operations is a new problem brought about by the increased use of welding in our war plants. In the past welding booths were stuck away in a dark corner, away from other employees so the blinding arc would not disturb them. Curtains enclosing such booths were either black, green or brown. Today there are not enough corners in plants to accommodate the amount of welding necessary—in fact welding is an integral part of assembly line operations in some plants. So the battle to reduce welding arc contrasts and decrease the seeing task of the welder is on. The ammunition is light and paint and the advance is just beginning to start. Lighting engineers are studying the problem and releasing their recommendations.

The following discussion of this subject is based on a set of recommendations presented, under the sponsorship of the local WPB office and the Chicago Lighting Institute, to an audience of industrial plant men at one of the Wartime Lighting Conferences held in Chicago.

Welding, from the viewpoint of seeing, presents one of the poorest conditions. The welding arc—one of the brightest of artificial light sources—creates a terrific glare source between the eyes and the work. The arc also gives off quantities of ultra-violet and infra-red rays—hence the elaborate protection of the welder's face, eyes, arms and hands. The glass in the welder's hood is universally No. 10 welding glass which absorbs all of the infra-red and ultra-violet rays—and all but .014 percent of visible rays. Thus, from the time the welder lowers his hood until he strikes the arc, the work

[Continued on page 140]

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Examine a Wheeler Fluorescent Fixture, for example. Compare its high rigidity, obtained in spite of WPB metal-restriction, by Wheeler's I-beam wiring channel construction. Notice that wiring is *completely metal-enclosed*, yet instantly accessible. Also note the accessibility of starter switches; the speedy adaptability of the unit to continuous runs; and the ample provision of knock-outs for any type of mounting.

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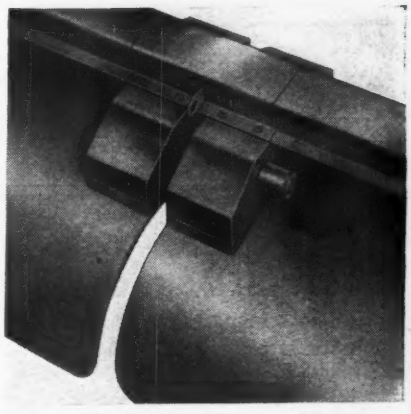
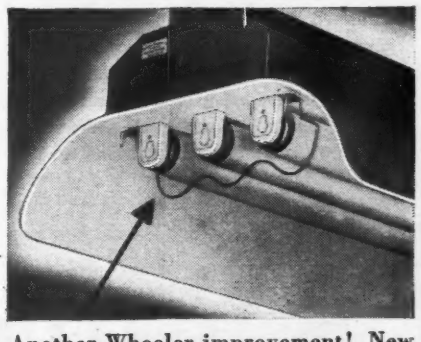


Simpler Wheeler coupling speedily adapts single units to continuous runs. Note I-beam wiring channel design and accessible starter switches.



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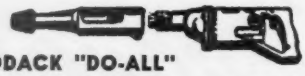

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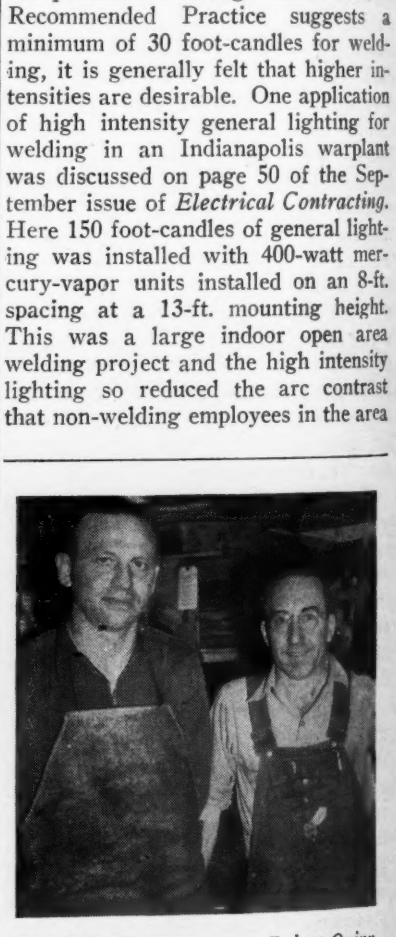
Modern Lighting

[FROM PAGE 139]

is almost totally obliterated. This causes some welders to strike the arc before lowering their hoods—a practice that is extremely dangerous to eye health.

Solution of Problem—Obviously the solution to this problem is to provide sufficient illumination to permit the welder to see the position of the work through his filter glass (enough to permit him to strike the arc in the proper place) and at the same time reduce the contrast of the welding arc with the surroundings. With a decrease in contrast the operator will be able to follow the weld more closely, observing amount of overlapping and undercutting, slope of the crater, slope of the rod, speed, and so on. After the hood is removed, flaws and irregularities in the weld can be more readily noticed.

General Lighting—A good general lighting system will do much to solve the problem. Although the American Recommended Practice suggests a minimum of 30 foot-candles for welding, it is generally felt that higher intensities are desirable. One application of high intensity general lighting for welding in an Indianapolis warplant was discussed on page 50 of the September issue of *Electrical Contracting.* Here 150 foot-candles of general lighting was installed with 400-watt mercury-vapor units installed on an 8-ft. spacing at a 13-ft. mounting height. This was a large indoor open area welding project and the high intensity lighting so reduced the arc contrast that non-welding employees in the area



WORLD WAR II veteran Robert Quinn (left) now does motor rewinding under the guidance of Karl Eisele, foreman of the electrical department of the Wisconsin Foundry and Machinery Co., Madison. After 1½ years of service in the Coast Artillery branch of the U. S. Army, including action at Guadalcanal, Bob received a medical discharge and went back to his old company and a new job.

ENTERPRISING ELECTRICAL CONTRACTORS of Richmond, Virginia, are G. C. Chewning, Pres. and on the right is T. W. Wilmer, Secy. and Treas. of Chewning and Wilmer, Inc. With new construction falling off, they are grateful that they didn't abandon their industrial and commercial maintenance during the lush government contract days.

were not distracted. The mercury-vapor unit was recommended because of its efficiency and the fact that its blue-green color blends well with the color of the welding arc.

Painting—of surrounding areas and objects, such as walls, ceilings, columns, welders' frames, jigs, etc., in a light color increases the efficiency of the general lighting and aids reduction in arc contrast. White zinc-oxide paint, either dull or gloss, has the property of absorbing the harmful ultra-violet rays and is highly recommended for this purpose. This was used in the Indianapolis plant mentioned above. Painting the work itself with a prime coat of light colored paint also helps, utilizing the light of the arc to best advantage, reducing brightness contrast between the arc and work and increasing the visibility of the work.

Local Lighting—must be used to supplement general lighting when the work is pocketed or so surrounded as to be in shadow. Extension cords and portable bench and floor stands should be equipped with shockproof guards and mill-type or splatterproof bulbs. Floor stands with four 20-watt fluorescent lamps in a 24-inch square reflector may also be used. Two such units are on the market, one with four 40-watt fluorescent tubes on a scooter stand, the other with incandescent lamps in a large area reflector with a cover glass.

Layout Tables—are best lighted by large area, low brightness fixtures since visibility is obtained by a glow over the entire work surface causing flaws and scribe and centerpunch marks to stand out as dark lines and marks. An intensity of 50 to 75 foot-candles should be provided. However, if there are vertical barriers, overhangs, and

[Continued on page 142]

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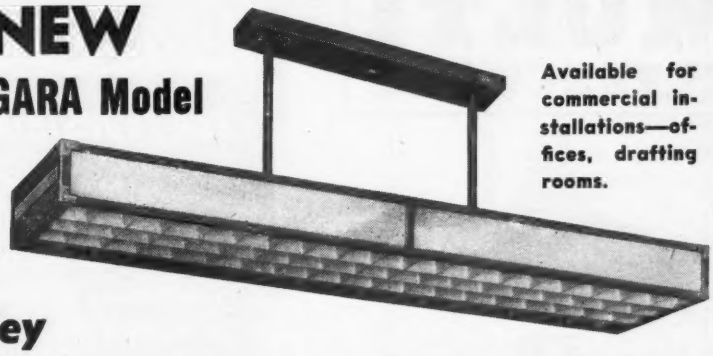

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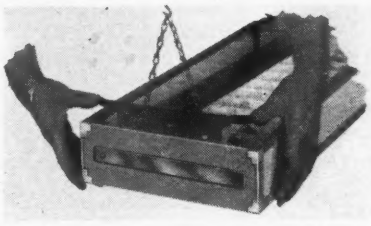

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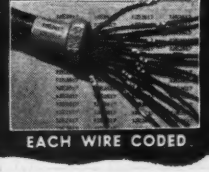

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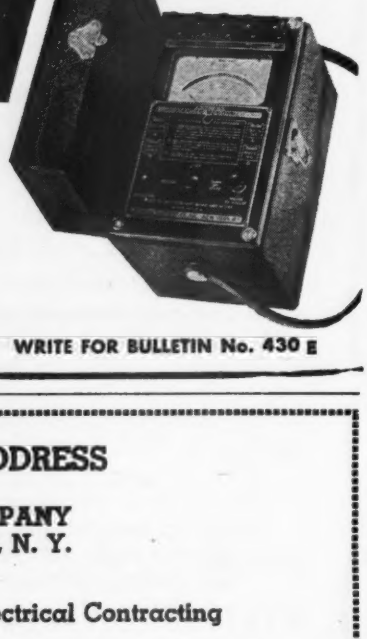

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Modern Lighting

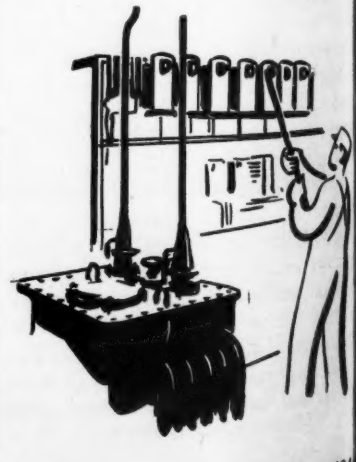
[FROM PAGE 141]

deep pockets, vertical plane illumination will be necessary, requiring perhaps one or more local lights (discussed above).

Booth Lighting—is frequently provided by fixtures mounted over the booths (normally set back to back). Under these conditions welders or trainees must work in their own shadow or frequently the light comes in on the wrong side of the vertical fin. To overcome this, the investigating committee suggests the use of a single lamp, 20-watt fluorescent fixture mounted vertically at the top, from corners of each booth (extending from the booth top down). This arrangement would provide good light on the work, and would eliminate shadow and light reflection from the welder's hood glass.

Brazing—is usually done on a normal height work bench with the operators wearing No. 4 welding goggles. Recommended lighting for this task calls for use of 100-watt fluorescent R.L.M. fixtures mounted over and in line with the outer edge of the bench. Surrounding walls and objects should be painted in a light color to reflect the light upon the work and reduce contrast. An installation of this type provides from 40 to 50 foot-candles of illumination.

Inspection—There is a tendency to use extension cords with bare lamps and guards for this type of work. Here the inspector must look past the bare lamp to see the welds. The unit recommended is a lamp with a reflector and handle so the operator can direct the light upon the work and away from his eyes. A diffusing plate on the front of the reflector will prevent back reflections and will be helpful in keeping glaring sources out of the eyes of nearby workers.



Electric Welding At Higgins

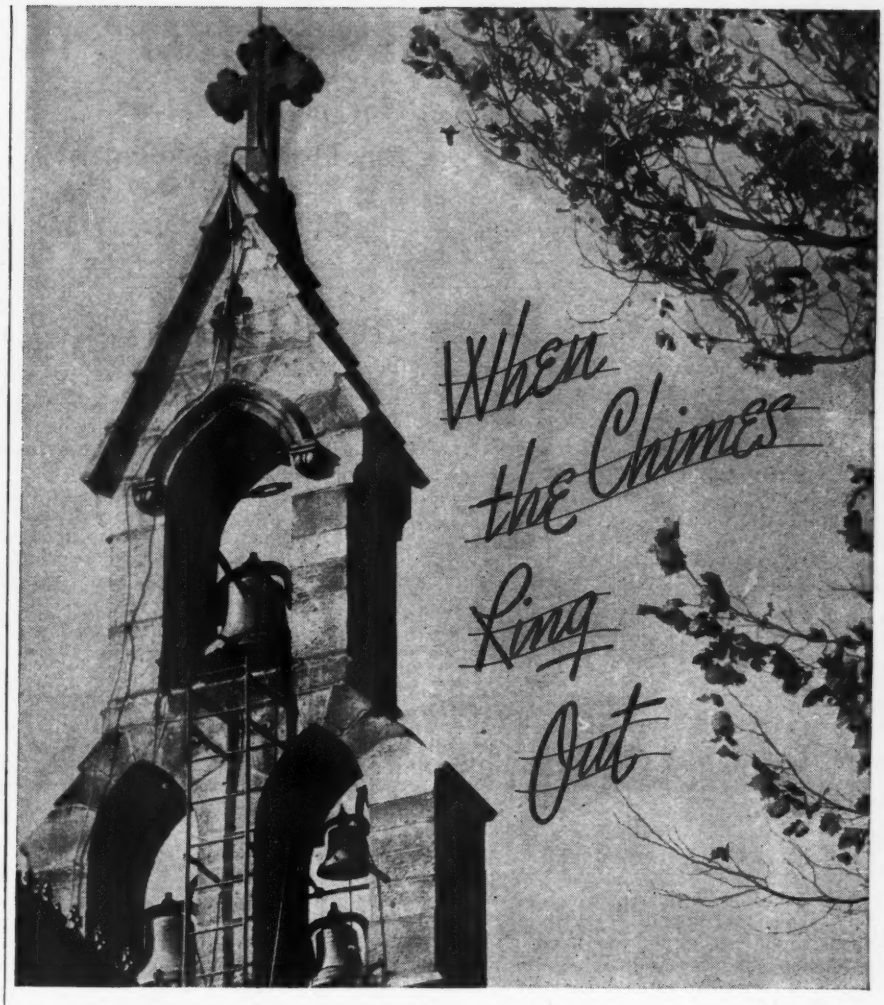
[FROM PAGE 47]

fed from the underground high tension system (see photo). A steel channel, bridging the poles, supports the primary fused disconnects. The secondary buses consist of four 1¼-inch IPS copper tubes per phase leg (980 amp. per conductor or 3,920 amp. per phase).

Considerable welding is still done on the ships once they emerge into the open yard. Here the welding units are mounted on double-tier platforms, 30-ft. long and 7-ft. wide. Like the indoor scheme, these platforms are elevated, the first being 10 feet above the ground and the second, 7½ feet above the first. Four 60-ft. wood poles, set 10-ft. in the ground, support the steel I-beam mezzanines. A gable roof, about 10-ft. above the second tier, extends over the edges of the platforms sufficiently to protect the equipment from the weather.

Each welder rack is fed by an underground, 3-phase, 440-volt circuit of 500 MCM. cables terminating at the level of the open wire bus (three cables in a vertical plane) strung across the length of the first mezzanine and dead-ended at the poles. Drops to the individual welder disconnect switches are of 4/0 cable with bus connections made with plastic insulated solderless connectors. The metal tops of the disconnect switches were removed and replaced with ¼-inch fibre. Opposite the service, at the other end of the platform a second conduit riser carries the 500 MCM. cables up to the level of the open bus on the second mezzanine, where the same scheme of distribution is used.

Power factor correction is provided by a 90 kva. bank of capacitors on each platform of 10 – 300-amp. welding units. Protection against capacitor high voltage surges on a single welding unit following a feeder outage is provided by a magnetic interlocking circuit between groups of welders and the capacitors. Individual contactors, whose holding coils are connected in parallel with the holding coils of the welder starting switches, are series connected in groups of three and four. These series groups, in turn, are parallel to the holding coil of the capacitor magnetic switch. Thus, a complete group of three or four welders must be in operation before the capacitor is returned to the circuit (see accompanying diagram). The small toggle switch in the control circuit permits manual control of the capacitor through the magnetic switch.



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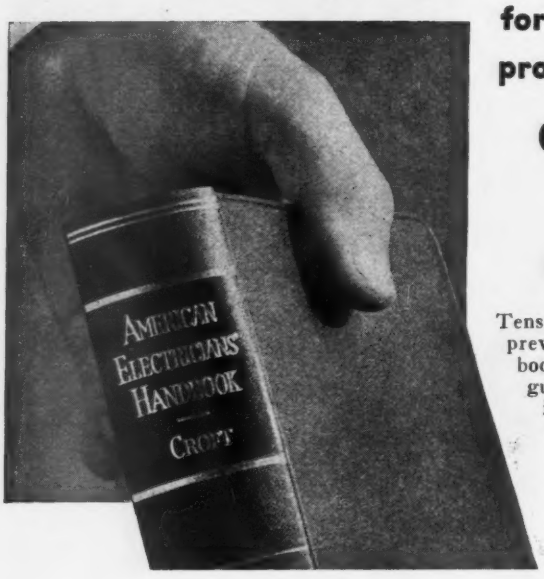

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Breaking Power Factor Bottlenecks

[FROM PAGE 43]

a graphic wattmeter with two current transformers, a voltmeter (range 0-750), and a clip-on ammeter (range 0-1000). To prevent interruption to production schedules, instruments must usually be inserted in the circuits when the plant is operating at lightest load—hence the importance of the graphic wattmeter to record the complete load cycle over a period of time.

The following steps were followed:

1. *Determine Peak Load*—A spot check with a clip-on ammeter at peak load was necessary to permit the choice of the proper current transformer ratio for the graphic wattmeter.

2. *Insert Graphic Wattmeter*—This was usually done at a minimum load point of the operating cycle—during the night, lunch hour, early morning or at such time when a short shutdown did not hinder production. To reduce shutdown time to a minimum, the current transformers were connected to the meter and the current and potential leads were all ready before the main switch was pulled. Where test links were not provided in the panel or switch, dummy fuse cartridges or some similar arrangement with current leads attached were inserted in the switch fuse clips. The graphic wattmeter was left in the main switchboard circuit for four days to record all load cycles for that period of operation. For records on distribution subfeeders, the meter was left in each circuit from 8 to 16 hours.

3. *Take Current and Voltage Reading*—Instantaneous current and voltage readings were taken with the clip-on ammeter and the voltmeter, generally at light, medium and maximum load conditions throughout the length of the meter test. Over a period of a week at least two readings a day are taken with more frequent voltmeter readings to check voltage conditions.

4. *Note Operating Conditions*—During the course of the survey, the operating conditions on the individual circuits were carefully noted and analyzed. Such conditions as overloaded, underloaded and idling motors, overmotored machines, bad bearings, excessively long feeders involving large voltage drops all have an important bearing on the power factor and general efficiency of the electrical system. These conditions were carefully checked and incorporated in the final report to present to the management the under-

lying causes of the low power factor conditions.

Power Factor Calculations

The four steps outlined above constituted the extent of the actual field work in the plant. Once the meter data was secured the rest of the survey was completed in the contractor's office. From here on to the preparation of the final report it was a question of calculating power factor and the requisite size of capacitors to remedy the condition. The series of computations fell into the following pattern:

1. *Analyze Wattmeter Charts*—The wattmeter charts (Fig 1) were made to provide a graphic picture of the actual total plant and individual feeder circuit load conditions. A careful analysis of these charts told the whole story—the idling or shutdown periods, the build up periods, the peak load, which feeders were carrying overloads, etc. The average kw. load was determined from these charts and used with the instantaneous current and voltage values, taken during the same time interval, to compute the power factor of the circuits under test at that time.

2. *Compute Power Factor*—Once the kw. load (avg.), amperes, and volts were known, the kva. was readily calculated (Formula 1, Fig. 2). Knowing the kw. and kva., power factor was determined by solving formula 2, Fig. 2. This was done for each reading taken at the main service to determine the average power factor of the entire plant. Similar computations were made to determine the power factor of the individual feeder circuits.

3. *Compute Reactive KVA*—The prime value that must be considered when raising the power factor is the reactive kva. (rkva.) of the circuit. This is the quantity that indicates the wasted power in the circuit and must be reduced to release the additional capacity needed in the existing circuits. The circuit rkva. was calculated by solving formula 3, Fig. 2, using the chart kw. and the computed kva. This value was later used to determine the size of capacitor needed to raise the power factor to the desired level.

4. *Calculate Capacitor Size*—Before actual capacitor calculations were started it was necessary to decide where the correction was to be applied—at the service, individual panels or individual machines. There were no large individual machines causing the trouble, so machine correction was

[Continued on page 146]

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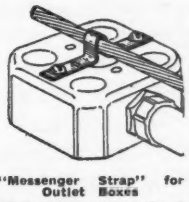

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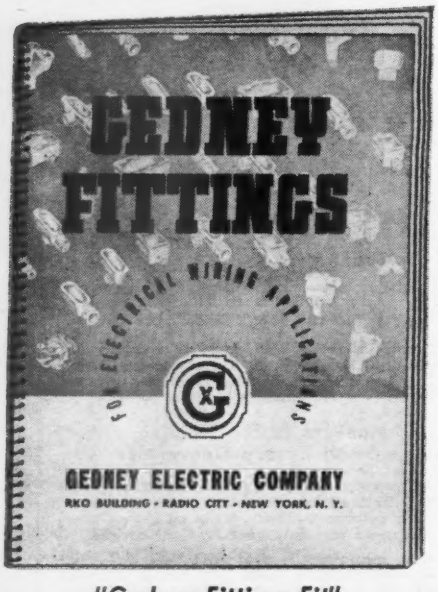

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Breaking Power Factor Bottlenecks

[FROM PAGE 145]

out. The apparent wide variation in the power factor of the individual feeders led to the decision to place the capacitors at the distribution panels. Capacitor sizes were calculated for correction to 90 percent power factor for each panel.

Since the reactive kva. is the quantity that must be reduced, it is obvious that the rkva. of the system at the corrected power factor (90%) must be known. Then the difference between the rkva.'s of the original and corrected system will indicate the size of capacitor needed. The first step is to calculate the circuit KVA. at the corrected power factor (90%). This was done by solving formula 4, Fig. 2, using the chart kw. reading and the corrected power factor value. Then using the new kva. (at 90 percent power factor) and the chart kw. reading, the rkva. at 90 percent power factor was computed by solving formula 5, Fig. 2. The difference between the original and corrected rkva. (see calculation 6, Fig. 2) indicates the reduction in rkva. due to the power factor correction and hence the size of capacitor needed to achieve this result. The nearest commercial size capacitor was recommended (see statement 7, Fig. 2).

5. *Tabulate All Data*—There is no question but that the best way to present data of this type is in tabular form. This was done with the recorded and computed data. Table 1 covers the recorded and calculated values pertinent to the power factor determinations of the plant service and the individual feeder circuits. It clearly indicates where the largest power factor losses are occurring and tells at a glance why panel correction was chosen. Table 2 presents the results of the corrective capacitor calculations and indicates the computed and commercial sizes of corrective capacitors recommended.

In addition to the above tables, drawings, showing the original electrical service and distribution and the recommended changes with capacitor indications, were made to include in the final report of the survey.

Making the Report

All of the work involved in making a survey of this type may be lost if the report of the findings is not concise, yet comprehensive. The plant management does not watch the mechanics of the survey, but it will want to know the full story.

Capital Electric Company submitted to the plant management the following six page double spaced typewritten report set in an individual paper binder. The body of the report contained the following material:

1. A general description of the existing electrical service and distribution system.

2. A description of the mechanics of the survey.

3. Tables of recorded and calculated data showing the results of the survey and the conclusions reached.

4. Charts from the graphic wattmeter. These were returned to the contractor after study by the management. However, if management requested a record, prints of the charts could be made and submitted.

5. An explanation of the conclusions reached, pointing out:

a. The disadvantages of operating under low power factor.

b. The causes of low power factor in the plant.

(In this case it was voltage drop on long feeders, motors running at full load only a small portion of their total operating time, and idling motors).

6. Recommendations for remedying the conditions. In this case these included the installation of capacitor units as outlined and the rehabilitation of the electrical system by installing an up-to-date service and busway distribution to reduce voltage drop and provide flexibility.

7. A description of the equipment recommended and a general word picture of the proposed installation.

8. Blueprints of the recommended changes to augment the description in the body of the report.

9. A bid proposal to execute, for a definite sum, the recommendations made and install the equipment described in the manner outlined.

10. Delivery dates of equipment and the priority rating on which such deliveries are predicated.

11. A proposal to, if awarded the work, obtain graphic wattmeter charts of the corrected system to indicate corrected condition.

This is an outstanding example of the value of instruments in the contractor's organization. Here, a contractor who was on his toes apprised a plant of its inefficient electrical system, got the job, gave the plant an efficient electrical design and further cemented the bonds of business relationship.

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Blood plasma boxes	Set up a Paper Conservation Board in your plant.

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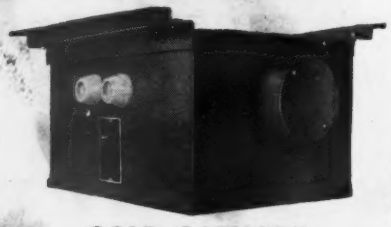

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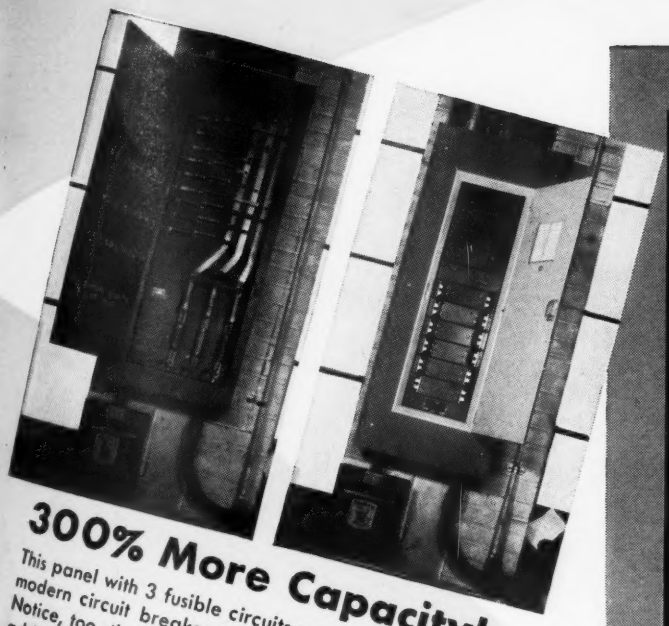

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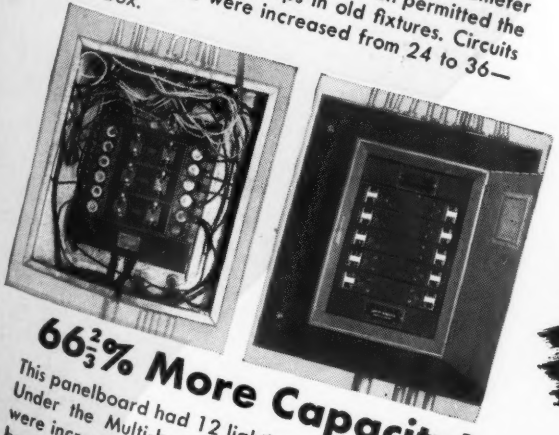

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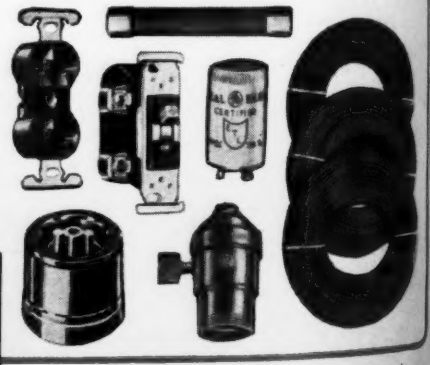

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